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ABSTRACT

The purpose of the 1988-89 Learning Assessment Retention Consortium (LARC) Student Outcomes Study was to describe the goal satisfaction, retention, and skills acquisition of students who were enrolled in remedial or precollege math courses in 23 California community colleges. Three methods of data collection were used: pre- and post-tests to measure skills acquisition; pre- and post-surveys to measure changes in and accomplishment of educational goals; and data collection from college records to determine student persistence and academic performance. The study sample of over 10,000 students was comprised of four fall 1988 math sections at each college at each of the test levels (i.e., College Arithmetic, Beginning Algebra, Intermediate Algebra, and Precalculus/College Algebra). Study findings included the following: (1) at the end of the math course, 25% of those who initially selected the goal of a bachelor's degree with an associate degree selected another goal on the post-survey; (2) two-thirds of those who initially selected non-degree goals chose a degree goal on the post-survey; (3) when the math students were asked to assess their math skill levels prior to the course, 5% rated their skill as very poor, 18% poor, 52% okay, 20% good, and 4% very good--the post-survey distribution of responses indicated that students felt that their math skills had improved; (4) in each of the math courses studied, there was substantial skills gain at the end of the course; and (6) 50% of the students completed their math course with an A, B, or C grade. The student questionnaire and scores by college groups and colleges are appended. (WJT)

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Mathematics

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Learning Assessment Retention Consortium

Student Outcomes Studies

Final Report ■ Year 3 ■ October 1989

Learning Assessment Retention Consortium

STUDENT OUTCOMES STUDY

Year Three

Final Report

Mathematics

Funding for the study was provided by a Fund for Instructional Improvement grant from the California Community College Chancellor's Office. The Mathematical Association of America supported the study by substantially reducing their usual licence fee for the use mathematics tests they developed. Palomar College supported the study through the services of several staff and provided central data processeing services and equipment. Palomar College's Office of Institutional Research and Planning provided study direction, coordination, and analysis.

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Executive Summary

Executive Summary

with Comparisons to the

Year 1/Writing and Year 2/Reading Outcomes Studies Findings

Purpose of the Study

The purpose of the 1988-89 LARC Student Outcomes Study is to describe educational outcomes of students who enroll in remedial or precollege math courses. The study focused on three sets of outcomes: 1) student goal satisfaction, 2) retention, and 3) skills acquisition. More specifically, the questions addressed within each of these outcomes categories are:

1) Student goal satisfaction

- Do students change their educational goals after enrolling in math courses?
- What number and percent of students accomplish their objectives for enrolling in math courses?

2) Retention

- What number and percent of students:
  - successfully complete (A,B,C, or CR grade) their remedial or precollege math courses?
  - re-enroll in college the following semester?
  - re-enroll in math courses the following semester?
- Do students enrolled in remedial or precollege math courses progress in college by enrolling in a larger proportion of college level courses in subsequent semesters?

3) Skills acquisition

- Do students enhance their math skills, as measured by pre-math tests/post-math tests?
- Do students in math courses become more confident of their math ability and ability to succeed in college?

Study Design

The research design used for the Year 3/Math outcomes study is essentially the same as that used for the LARC's Year 1/Writing and Year 2/Reading outcomes studies. Three methods of data collection were used, each corresponding to one of the three outcomes criteria to be measured:

Pre- and Post-testing for measurement of skills acquisition. An Advisory Committee selected a set of four tests developed by the Mathematical Association of America (MAA): an Arithmetic Test, a Beginning Algebra Test, an Intermediate Algebra Test, and a Precalculus Test. Each MAA test consists of 25 items except the Precalculus Test which has 20 items. Answers are selected from five choices. The time allotted for each test is 25 minutes.

Participating colleges administered the tests during the first week of the Fall 1988 semester and then again during the last week of the semester. In order to enable some comparison of entrance and exit skills among the levels, students were asked to take a second post-test. The second post-test was the same test they would take as a pre-test if they were to take the next higher level course. For example, Beginning Algebra students not only took the Beginning Algebra Test as the pre- and post-measurement of their Beginning Algebra skills, but also took the Intermediate Algebra Test at the end of the semester. Their exit score on this Intermediate Algebra Test could then be directly compared to the pre-test entrance score of those students taking Intermediate Algebra.

Pre- and post-surveys for measurement of student educational goal satisfaction. During the period that students were pre- and post-tested for skills acquisition they responded to brief pre- and post-surveys regarding their educational goals, self-assessments of math ability and college success, and demographic characteristics. Students also indicated the total number of units they were taking and the number of remedial reading, writing, or math units they were taking.

Data collection from college records for determining student persistence and performance. College contact persons were provided report forms in early Spring 1989 listing each of their students who had taken a pre-test or post-test during the Fall 1988 semester. College staff recorded on these report forms 1) the number of remedial and non-remedial units the student was taking in the Spring 1989 semester, if any, 2) the grade received in the Fall math course, and 3) whether the student was enrolled in another math course in the Spring 1989 semester.

Sample

The sample of students participating in the math outcomes study is demographically similar to the samples that participated in the writing and reading studies. Over half of the math sample are 19 years old or younger. The sample represents the ethnic diversity of California community college students in that 21% are Hispanic, 11% Asian, 7% black and 2.5% Philippine American.

Like students participating in the reading and writing outcomes studies, the math participants overwhelmingly indicated on the pre-survey that they intended to obtain a Bachelor's degree. Fifty-two percent indicated they planned to achieve the Bachelor's degree without acquiring an Associate's degree while 22% said they planned to acquire the Associate's degree as well. Thirteen percent of the sample were pursuing only the Associate's degree at the beginning of their math class while 3% were pursuing a vocational certificate and 7% had other goals such as personal development, job skill enhancement, or a high school diploma.

Student Goals

At the end of the math course, students were questioned about their goals again and while the overall distribution of post-survey goals choices was virtually identical to the

pre-survey distribution, many students had changed their choices. For example, 25% of those initially selecting the goal of a "Bachelor's With AA" selected another goal on the post-survey. Thirty-seven percent of those initially selecting Bachelor's only, and 43% of those initially selecting "Associate's Degree Only" selected other goals on the post-survey. Fully two-thirds of those initially selecting non-degree goals selected a degree goal on the post-survey.

Results similar to these were also found in the LARC writing and reading studies. This indicates that, given categories of this type at least, students frequently reassess and change their educational goals. But at another level perhaps student's goals are more stable than these figures indicate. Of those students switching from Bachelor's With AA to another goal, the great majority selected Bachelor's Only. Similarly, of those switching from an initial Bachelor's Only, the great majority selected Bachelor's with AA. This suggests that the basic goal, a Bachelor's degree, remains stable, but that the specific means or pathway to that may change frequently. Such changes in pathways may also be reflected in changes of major. Students initially selecting goals other than a Bachelor's tended to select "higher" goals at the end of their math course.

Self-Assessment of Skills

Math students were asked on both the pre and post-surveys to assess their level of math skills. A five-point scale was used. On the pre-survey, for course completers, the distribution was: 5% very poor, 18% poor, 52% okay, 20% good, and 4% very good. This is a very symmetrical distribution centered around okay. On the post-survey, the distribution was: 2% very poor, 8% poor, 57% okay, 20% good and 3% very good. The post-survey distribution is shifted up compared to the pre-survey distribution. This indicates that students felt their math skills had improved as a result of completing their math class. Similar results were noted in the writing and reading outcomes studies.

Skills Acquisition

The students' self-assessment of skills gain are confirmed by the results of the pre-testing and post-testing for skills acquisition in all three LARC outcomes studies. For each of the five levels of math courses studied (Arithmetic Skills, College Arithmetic, Beginning Algebra, Intermediate Algebra, and College Algebra) there is substantial skills gain. Student end-of-course scores on the tests designed by the Mathematical Association of America averaged 27% to 98% higher than their corresponding pre-test scores.

While such gains are significant and substantial, they can take on greater meaning when placed in the context of a continuation of pre-scores and post-scores along the five levels from Arithmetic Skills to Precalculus. Ideally for such a comparative context, the same test would be administered pre and post at all levels. This, in fact, was possible in the LARC writing outcomes study. Two tests were used across the entire range. A writing sample test and sentence sense test measured pre-skills and post-skills across four levels of writing courses.

Such a procedure, because of the greater variation in course objectives and content, was not possible in either the reading or math study. However, the math study was designed so that students took two post-tests. One post-test was the same as their pre-test and thus could be used to measure skills gain within the course. The other post-test was the same test that was used as the pre-test for the next level up. This enabled a comparison of "exit" scores to the "entrance" scores at the next level up.

For example, those completing beginning algebra not only took a beginning algebra test but also an intermediate algebra test. The average score on the exit intermediate algebra test by the beginning algebra students was 4.3. The average score on the entrance intermediate algebra test by the intermediate algebra students was 5.3. A similar gap in scores was found in comparing exit College Arithmetic students with entrance beginning algebra

students and exit intermediate algebra students with entrance College algebra students. However, the average exit Arithmetic Skills score was the same as the entrance College Arithmetic Skills score.

Math students, on these measures then, show substantial skills gain within their pre-college/remedial math courses, but, on average, not enough gain to achieve the average entrance skills at the next higher level (with the exception of the Arithmetic Skills to College Arithmetic transition). The writing outcomes study produced exactly parallel findings for pre-college/remedial writing courses (with no exceptions).

The proportion of students whose exit scores were equal to or greater than the next higher level average entrance score was also calculated. This is one measure of the proportion of students "ready" for the next level. On this measure, 47% of the Arithmetic Skills students were ready for College Arithmetic; 32% of the College Arithmetic students are ready for beginning algebra; 34% of beginning algebra students are ready for intermediate algebra; and 24% of intermediate algebra students are ready for Precalculus. Corresponding figures from the writing study are: 48% of 3 levels below college writing are ready for 2 levels below writing; 41% of 2 levels below are ready for 1 level below; and 50% of 1 level below are ready for college writing.

Course Success

Two other measures of outcomes is the proportion of students successfully completing their course and the proportion who enroll in courses the following term. In the math study, of the approximately 10,000 students who took the pre-tests and for whom data was submitted, 50% completed their course successfully, that is, with a grade of A, B, C, or credit; 19% completed their course unsuccessfully in that they received grades of D, F or no-credit; 31% did not complete their course having withdrawn or received a grade of incomplete. In

the writing study, 67% of the sample of approximately 5,200 were successful; 18% were unsuccessful; and 15% did not complete their course. In the reading study, 70% of the sample of 3,800 were successful; 15% were unsuccessful; and 16% did not complete their course.

Persistence

Regarding persistence in college, 82% of the initial fall math sample enrolled in courses the following spring. Corresponding persistence figures from the writing and reading study are 82% and 78%, respectively.

Introduction

Introduction

Background of the Study

Promoting student success is the major goal of the California community colleges. This goal is also the focus of LARC: the Learning, Assessment, Retention Consortium. Formed in 1981 and currently including 80 colleges, members of this network share a common purpose: to translate concern about student success into local action. From the beginning, LARC has identified research as a major priority, a critical link in accountability, and a viable mechanism by which to accomplish their purpose.

Recognizing a statewide need for information with which to evaluate and improve programs in 1986, LARC identified the measurement of selected student outcomes as a major research priority.

LARC's goal was to develop a generic student outcomes assessment model and to pilot test the model in remedial writing programs in California community colleges in 1986-87. That project was successfully completed in 29 colleges. In 1987-88 the outcomes assessment model was implemented in the reading programs of 28 California community colleges. In 1988-89 the model was implemented in mathematics programs in 23 California community colleges. This publication is the final report of this third year of the LARC student outcomes study series.

Purpose of the Study

The purpose of the 1988-89 LARC Student Outcomes Study is to describe educational outcomes of students who enroll in remedial or precollege math courses. The study focused on three sets of outcomes: 1) student goal satisfaction, 2) retention, and 3) skills acquisition. More specifically, the questions addressed within each of these outcomes categories are:

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- What number and percent of students:
  - successfully complete (A,B,C, or CR grade) their remedial or precollege math courses?
  - re-enroll in college the following semester?
  - re-enroll in math courses the following semester?
- Do students enrolled in remedial or precollege math courses progress in college by enrolling in a larger proportion of college level courses in subsequent semesters?

3) Skills acquisition

- Do students enhance their math skills, as measured by pre-math tests/post-math tests?
- Do students in math courses become more confident of their math ability and ability to succeed in college?

The project also adds another large, descriptive data base about student outcomes in California community colleges to the two databases created by the LARC writing and reading outcomes studies. This accomplishment is a "first" by a group of volunteering colleges. It is now possible to make accurate, research-based descriptive statements about large groups of California community college students. By using standardized measurement criteria and consistent terms in these studies, comparability of the results is assured, making the findings valuable and meaningful to local colleges.

The Generic Student Outcomes Assessment Model

The potential outcomes, or results and impacts, of postsecondary education are many. Student outcomes are often categorized as quantitative or qualitative, short-term or long-term, cognitive or affective, and as impacting society at large or impacting individuals. Because LARC believed that describing only one dimension of student outcomes was inadequate, the outcomes assessment model they developed included multiple outcomes and criteria:

- Student educational and course goal satisfaction
- Student persistence in courses and in college
- Skills acquisition in courses.

This outcomes assessment model may be used to assess outcomes of students enrolled in any community college course, program, or set of programs. The outcomes criteria identified are applicable to all community college curricula.

The Year 3/Math Student Outcomes Study Design

The research design used for the Year 3/Math outcomes study is essentially the same, therefore, as that used for the Year 1/Writing and Year 2/Reading outcomes studies. Three methods of data collection were used, each corresponding to one of the three outcomes criteria to be measured:

Pre- and Post-testing for measurement of skills acquisition. A study Advisory Committee consisting of prominent members of the California Mathematics Council for Community Colleges (CMC^3), the study director and associate director and the director of the previous LARC outcomes studies, and college representatives, reviewed a range of test instruments to measure skills gained in the five levels of math courses to be studied: (Basic) Arithmetic

Skills, College Arithmetic, Beginning Algebra, Intermediate Algebra, and Precalculus. The Precalculus level is a college algebra or precalculus course that does not include trigonometry. It had been hoped that a single test could be found that would measure skills gains at all five levels. This would enable direct comparison of the "entrance" and "exit" skills among the five levels similar to that made in the Year 1/Writing outcomes study. Unfortunately, a single instrument could not be found. The range of course objectives and skills from Arithmetic Skills to Precalculus are to great.

Certain math tests well known to California community colleges were determined to be unsuitable because they were so frequently used as placement tests. Selecting one of there tests would mean that many of the study's students would take the same test twice within weeks of the beginning of their math class. The Advisory Committee selected a set of four tests developed by the Mathematical Association of America (MAA): an Arithmetic Test, a Beginning Algebra Test, an Intermediate Algebra Test, and a Precalculus Test. The Advisory Committee determined that the Arithmetic Test should be slightly modified to include several items requiring problem-solving skills in addition to the item measuring numerical calculation skills and that the trigonomety questions be dropped from the Precalculus Test. A licence was obtained from the MAA to used and duplicate the tests for the purposes of this study. LARC acknowledges gratefully the MAA's support of this study through their substantial discount to their usual licence fee.

Each MAA test consists of 25 items except the Precalculus Test which has 20 items. Answers are selected from five choices. There is no penalty for incorrect answers. The time allotted for each test is 25 minutes.

Participating colleges administered the tests during the first week of the Fall 1988 semester and then again during the last week of the semester. In order to enable some

comparison of entrance and exit skills among the levels, students were asked to take a second post-test. The second post-test was the same test they would take as a pre-test if they were to take the next higher level course. For example, Beginning Algebra students not only took the Beginning Algebra Test as the pre- and post-measurement of their Beginning Algebra skills, but also took the Intermediate Algebra Test at the end of the semester. Their exit score on this Intermediate Algebra Test could then be directly compared to the pre-test entrance score of those students taking Intermediate Algebra. It was also decided to administer the Arithmetic Test as a pre-test for Beginning Algebra students as well as the Beginning Algebra Test. This would ensure that these students would experience some success in answering items during their pre-testing. The lineup of pre- and post-tests was thus:

Course/Level	Pre-tests	Post-tests
Arithmetic Skills	Arithmetic Test	Arithmetic Test
College Arithmetic	Arithmetic Test	Arithmetic Test Beginning Algebra Test
Beginning Algebra	Beginning Algebra Test Arithmetic Test	Beginning Algebra Test Interm Algebra Test
Intermediate Algebra	Interm Algebra Test	Interm Algebra Test Precalculus Test
Precalculus	Precalculus Test	Precalculus Test

Pre- and post-surveys for measurement of student educational goal satisfaction. During the period that students were pre- and post-tested for skills acquisition they responded to brief pre- and post-surveys regarding their educational goals, self-assessments of math ability and college success, and demographic characteristics. Students also indicated the total

number of units they were taking and the number of remedial reading, writing, or math units they were taking. Instructors listed college remedial courses on the blackboard at this time to insure consistency of definition.

An attempt was also made to survey students dropping the course prior to post-testing and post-surveying.The "drop survey" is similar to the post-survey except that it also requested that the student select a reason for dropping prior to the end of the term. Whenever possible, instructors would request dropping students to complete the survey at the time they dropped the course.

Data collection from college records for determining student persistence and performance. College contact persons were provided report forms in early Spring 1989 listing each of their students who had taken a pre-test or post-test during the Fall 1988 semester. College staff recorded on these report forms 1) the number of remedial and non-remedial units the student was taking in the Spring 1989 semester, if any, 2) the grade received in the Fall math course, and 3) whether the student was enrolled in another math course in the Spring 1989 semester.

All data collection instruments and answer sheets were submitted to the project director and associate director at Palomar College for analysis. The optically readable test and survey answer sheets were scanned into a computer database by project staff. A program written by the staff validated data entry via a series of error checking routines and scored the tests. The study associate director communicated frequently with each college during data collection to answer questions, to coordinate activities, and to insure consistency of study design implementation. College contact persons also had attended a day-long study implementation meeting prior to the start of the Fall 1988 semester. At this meeting a detailed testing manual was distributed and test administration details described and explained.

Organization of Study Results

This report was prepared by the Project Director and Associate Director and reviewed by the LARC Student Outcomes Advisory Committee, which includes professional researchers and math instructors. It has also been reviewed by the LARC Executive Steering Committee. The "Participants" section describes the sample colleges and students. This is followed by three sections of study findings, one relating to each of three outcomes criteria: student goal satisfaction, retention, and skills acquisition. Study methodology is addressed in each of those three sections. The report concludes with a brief summary of major findings and recommendations for other studies.

Participants And Sample

Participants And Sample

Colleges

In March 1988, a letter was sent to all California community colleges inviting participation in the Year 3/Math Student Outcomes study. Two information meetings of interested college representatives were held during that spring. By August 1988, 23 colleges and their math departments had volunteered to participate in the study. The participating colleges are listed in Table 1 together with their Fall 1987 enrollment, percent minority, location, and student sample size.

To determine whether the participating colleges were representative of all community colleges and thus whether the findings of the study could be generalized to all colleges, the 23 participating colleges were compared to the 107 California community colleges on enrollment size and student ethnic distribution.

The analysis of Table 2 reveals that on the most important comparison variable, ethnic distribution, the 23 sample colleges have enrollment distribution of minorities similar to that of all 107 colleges. However, the distributions of enrollment sizes of the sample colleges reflect a greater proportion of large enrollment colleges than all California community colleges. While 30% of all California community colleges have large enrollments, 48% of the sample have large enrollments.

Individually, the sample colleges are very diverse, as are all California community colleges. The range of enrollment sizes of sample colleges is from 1,182 to 20,754 (Fall 1987), and the range of ethnic minority composition is from 8% to 90%.

Table 1
Participant College Demographics

College	Enrollment	Percent Minority	Location	Student Sample Size
Small Enrollment Colleges (< 7,000)				
Gavilan College	3,699	33	Suburban	452
College of the Desert	6,282	28	Suburban	443
Compton Community College	4,644	90	Urban	142
Feather River College	1,182	8	Rural	145
Los Medanos College	6,226	24	Rural	338
Medium Enrollment Colleges (7,000 - 13,000)				
Rio Hondo Community College	12,952	62	Urban	528
Citrus College	9,166	35	Suburban	568
Glendale Community College	12,042	45	Suburban	479
Bakersfield College	10,429	28	Suburban	453
Cosumnes River College	8,554	30	Suburban	495
Butte College	9,200	18	Rural	426
Evergreen Valley College	7,084	66	Large Urban	565
Large Enrollment Colleges (>13,000)				
Palomar College	15,751	22	Suburban	616
Pasadena City College	20,286	57	Urban	583
Sacramento City College	13,893	46	Large Urban	506
Riverside Community College	15,042	31	Urban	425
Cerrito Community College	18,109	56	Urban	584
Rancho Santiago College	20,754	40	Large Urban	547
San Joaquin Delta CC	14,983	39	Urban	804
Mt. San Antonio College	19,803	45	Suburban	564
Santa Monica College	17,404	33	Suburban	616
American River College	19,329	22	Suburban	571
Diablo Valley College	20,043	16	Suburban	420

Table 2
Mean Total Enrollment and Mean Minority Enrollment of Study Colleges and All California Community Colleges

	All California Community Colleges			Study Colleges		
	Mean Enrollment	Mean Percent Minorities	Number	Mean Enrollment	Mean Percent Minorities	Number
Small Enrollment (< 7,000)	3,924	35	38	4,406	37	5
Medium Enrollment (7,000-14,000)	9,841	38	37	9,981	41	7
Large Enrollment (>14,000)	18,151	36	32	17,763	37	11
All	10,225	36	107	12,472	38	23

Based on Fall 1987 Chancellor's Office Enrollment Report.

Students

To create the sample of students studied, each college was asked to select, from the Fall 1988 semester, four math course sections for each of the four primary test levels (College Arithmetic, Beginning Algebra, Intermediate Algebra and Precalculus or College Algebra) for a total of approximately 16 course sections and 600 students at each of the larger colleges. Many colleges also selected students in a fifth level of math - Basic Arithmetic Skills. These sections were to be evenly selected from among all meeting hours of math courses. Smaller colleges, who enroll fewer students in their math program, usually submitted fewer sections and fewer students for the study.

Table 1 shows that the sizes of college pre-test samples ranged from 142 at Compton Community College to 804 at San Joaquin Delta College. All but five had sample sizes between 400 and 600.

Table 3 displays the student sample demographics by course level of ethnicity, age, sex, and whether the math course taken was a day or evening course. Ethnic minorities make up 46% of the total sample. Table 3 shows that 62% of the sample taking the lowest level course, Arithmetic Skills, are minorities. The proportion of Blacks and Hispanics decreases as the course level increases. On the other hand, the proportion of Asians substantially increases as the course level increases. According to the Chancellor's Office Fall 1987 enrollment report, 38% of California community college students are minorities.

The student sample is primarily of traditional college age. Seventy-three percent are 24 or younger. Forty-one percent are 19 or younger. The Chancellor's Office enrollment report shows that 43% of California community college students are 24 or younger.

Table 3 also shows that 53% of the student sample is female. The lowest level course, Arithmetic Skills, has 65% females and the proportion of females decreases as the course level increases. Females are only just over a third of those taking Precalculus. The

Table 3
Student Sample Distribution by Ethnicity and Course Level

	Arithmetic Skills		College Arithmetic		Beginning Algebra		Inter-mediate Algebra		Precalculus		Totals	
	N	Col %	N	Col %	N	Col %	N	Col %	N	Col %	N	Col %
Ethnicity												
White	274	38	1,138	52	1,494	56	1,640	57	1,184	53	5,730	54
Black	102	14	214	10	211	8	171	6	78	3	776	7
Hispanic	212	29	596	27	627	24	543	19	323	14	2,301	22
Asian	67	9	96	4	184	7	325	11	476	21	1,148	11
Philippine Am	20	3	43	2	59	2	74	3	79	4	275	3
Am Indian	25	3	54	2	42	2	40	1	25	1	186	2
Pacific Islander	8	1	20	1	10	.4	21	1	19	1	78	1
Alaskan Native	0	0	0	0	0	0	2	0	2	0	4	0
Other (Non-white)	13	2	32	1	36	1	44	1	52	2	177	2
Totals	721	100	2,193	100	2,663	100	2,860	100	2,238	100	10,675	100
Age												
19 and under	226	31	764	35	1,190	42	1,300	44	987	44	4,467	41
20 to 24	181	25	640	29	798	28	1,048	36	793	35	3,460	32
25 to 34	213	29	476	22	508	18	391	13	361	16	1,949	18
35 to 44	72	10	221	10	227	8	136	5	81	4	737	7
45 to 54	22	3	77	4	64	2	39	1	12	.5	214	2
55 and over	10	1	21	1	15	1	18	.6	12	.5	76	1
Totals	724	100	2,199	100	2,802	100	2,932	100	2,246	100	10,903	100
Sex												
Males	257	35	835	37	1,242	44	1,404	47	1,412	63	5,203	47
Females	481	65	1,392	63	1,597	56	1,555	53	834	37	5,931	53
Day/Evening												
Day	624	83	1,674	74	2,336	82	2,602	87	1,857	83	9,093	82
Evening	125	17	578	26	497	18	387	13	390	17	1,977	18

Chancellor's Office reports that Fall 1987 enrollments in California community college were 57% female.

The student sample is composed largely of students taking a day math class (82%, Table 3) and a full-time load (an average of 12.2 units, see Table 15). In addition, 74% expressed an intention to obtain a Bachelor's degree and 72% expressed the belief that they would be either "successful" or "very successful" in college. Fifteen percent indicated that they were receiving some financial aid. The Chancellor's Office reports that Fall 1987 credit enrollments of all California community colleges were 25% full-time and that 69% of total WSCH (weekly student contact hours) are generated in day classes.

In summary, the 11,275 (the number who completed either the pre-test or the pre-survey administered at the beginning of the semester) math students in this study sample are, as was the case with the two previous LARC student outcomes studies, primarily day students, young in age, full-time (taking an average of 12.2 units), and desire to obtain a Bachelor's degree. Only 15% are receiving financial aid. Most expressed confidence in their ability to be successful in college. Overall, 46% are ethnic minority students. Larger percentages of ethnic minorities are represented in lower math level groups (up to 62%). Given the statistics from the Chancellor's Office on the demographic makeup of all California community college students, it appears that the student sample for this study could be representative of those students who take math courses at the California community colleges.

As expected, some students did not complete their Fall 1988 math courses and thus were not available to complete post-tests and questionnaires administered as part of the study at the end of the Fall 1988 semester. In addition, some students who took the pre-test and completed the course did not take the post-test. Just over 50% of those taking the pre-test also took the post-test. Fewer took the post-test in higher level math courses than the lower

level courses. Consequently, sample sizes differ from analysis to analysis and depending upon the number of students for whom complete data is available.

Math Levels Used for Analysis

For most analyses, students in the sample are placed into groups determined by the level of the math course they took: (Basic) Arithmetic Skills, College Arithmetic, Beginning Algebra, Intermediate Algebra, Precalculus (or College Algebra). The Precalculus level is a college algebra or precalculus course that does not include trigonometry. The study evaluated the five course levels using four tests. The Arithmetic test was administered at both the College Arithmetic and Arithmetic Skills levels. Precalculus is considered to be the first college level math course among the five levels. However, Section 55805.5 of Title 5 of the California Education Code defines math courses below beginning algebra as remedial. Thus College Arithmetic and Arithmetic Skills are remedial courses while Beginning Algebra and Intermediate Algebra may be regarded as "pre-college."

Student Goal Satisfaction

Student Goal Satisfaction

Research Questions

1. Do students change their educational goals after enrolling in math courses?
2. What number and percent of students accomplish their objectives for enrolling in math courses?

Study Process

During the second week of the Fall 1988 semester, and again immediately prior to the end of the semester, students completed survey questionnaires in the classroom. At the beginning of the semester, they were asked to provide personal demographic and background information, to identify their educational goals and course objectives, and to assess their math ability. At the end of the semester, they were again asked to identify their educational goals, to assess their own math ability, and to state what they believed they had accomplished in their math course.

Students who dropped the course were asked to complete a survey form which included questions from the regular post-survey and questions regarding their reasons for not completing the course. While response rates were very low (N = 370, roughly 11% of those who did not complete their courses), as expected, the data collected nevertheless gives a sense of the status of those not completing their math courses.

Copies of the survey are contained in the appendices.

Educational Goal Change

Table 4 provides the distributions of the students' long-term educational goals at the beginning (pre-survey) and at the end (post-survey) of the Fall 1988 semester. The table shows that the 10,744 students who started the course had the same distribution of goals as

Figure for Table 4
Percentage Distribution of Educational Goals
Pre-survey vs. Post-survey Students

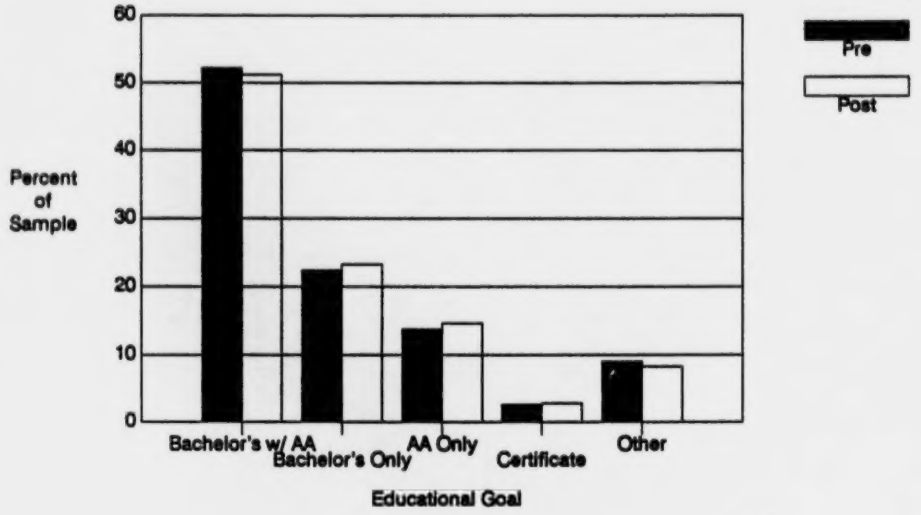


Table 4
Percentage Distribution of Educational Goals
Pre-survey vs. Post-survey Students

Educational Goal	Percent Pre-survey	Percent Post-survey
Bachelor's With AA	52	51
Bachelor's Only	22	23
AA Only	14	15
Certificate	3	3
Enhance Employment	3	3
HS Diploma	0	0
Personal Development	2	3
None	3	3
Number Surveyed	10,744	5,381

the 5,381 students who finished the course. In both cases, almost 75% of the students desired to obtain a Bachelor's degree. Fourteen percent sought only an AA degree while about 3% were seeking a vocational certificate.

Table 5 shows the distribution of student goal choices at the beginning of the semester and at its end for the 4,851 students who took both the pre-survey and post-survey. Table 4 and Table 5 together show that the distribution of pre-survey goals was essentially the same for 10,747 who started the course and for the 4,851 who took both the pre-survey and the post-survey.

Table 5 also indicates that the overall distribution of post-survey goals for completers is virtually the same as their distribution of pre-survey goals. However, Table 5 also provides data on the percentages of pre-survey goal choices that were chosen again by the same student on the post-survey. For example, of those completing both surveys, 74% of those who had indicated a Bachelor's With AA as their pre-survey goal also indicated the same choice on the post-survey. This implies that 26% of those initially choosing a Bachelor's With AA changed their minds by the time of the post-survey. Of those initially choosing Bachelor's Only, 63% maintained the same choice, while 37% choose another goal. For the goals of Certificate, Enhance Employment, High School Diploma, and Personal Development, 60% to 70% of the students chose a different goal on the post-survey than they did on the pre-survey. Thus, despite a stability in the overall distribution of goals from the pre-survey to the post-survey, many students make different goal choices over the course of a semester.

Table 6 provides further insight into these changes of goal choice. Table 6 is a cross-tabulation of pre-survey goal choices by post-survey choices for those completing both surveys. It shows that of the 53% who selected Bachelor's With AA on the pre-survey and then selected another goal on the post-survey, half selected Bachelor's Only (14% of the

Figure for Table 5
Percentage Distribution of Educational Goals of Students Taking Both Pre- and Post-surveys

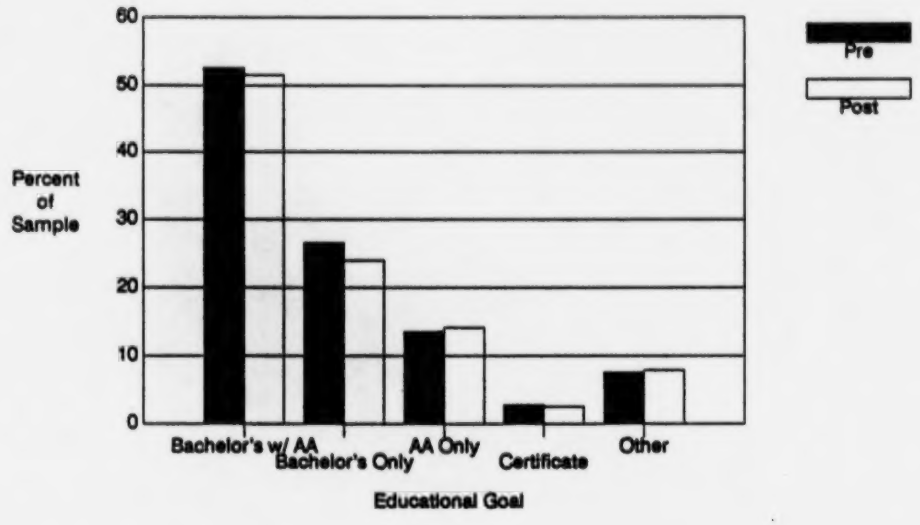


Table 5
Percentage Distribution of Educational Goals of Students Taking Both Pre- and Post-surveys

Educational Goal	Percent Pre-survey	Percent Post-survey	Precent of Pre- with same Post
Bachelor's With AA	53	52	74
Bachelor's Only	24	24	63
AA Only	14	14	58
Certificate	3	3	36
Enhance Employment	3	2	36
HS Diploma	0	0	31
Personal Development	2	3	42
None	3	3	25
Number Surveyed	4,851	4,851	65

Figure for Table 6
Percent of Pre-survey Students Choosing the Same Educational Goal on the Post-survey

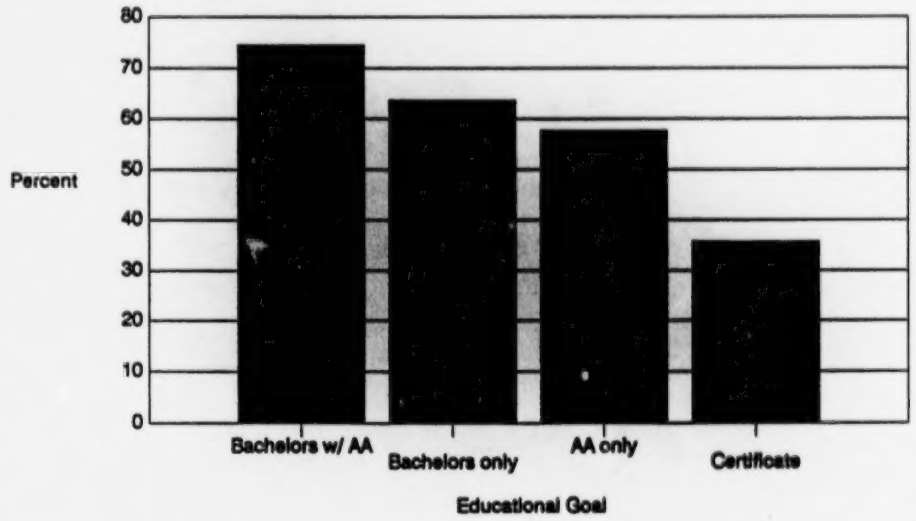


Table 6
Percent Distribution of Post-survey Goal Choice Given the Students' Pre-survey Choice

Post-survey Choice / Pre-survey Choice	Bachelor's With AA	Bachelor's Only	AA Only	Certificate	Enhance Employ-ment	HS Diploma	Personal Develop-ment	None of Above	Number
Bachelor's With AA	74	14	7	1	1	0	1	2	2,551
Bachelor's Only	28	63	4	1	1	0	1	2	1,147
AA Only	26	6	58	4	2	1	2	2	656
Certificate	19	4	27	36	7	0	5	2	135
Enhance Employment	14	7	15	5	36	0	18	6	124
HS Diploma	39	0	15	0	0	31	15	0	13
Personal Development	13	5	19	7	7	1	42	7	93
None of Above	32	23	10	2	4	0	5	25	132
Number	2,498	1,162	686	123	116	13	128	125	4,851

pre-survey Bachelor's With AA chose Bachelor's Only on the post-survey.) A fourth of those switching chose AA Only on the post-survey. The remaining one-fourth chose the other goals in a fairly even distribution.

Of the 37% switching from Bachelor's Only on the pre-survey to another goal on the post-survey, over 75% selected Bachelor's With AA, with most of the rest selecting AA Only. Of the 42% switching from AA Only to other goals at the end of the course, three quarters choose the "higher" goal of a Bachelor's degree (either with or without an AA).

Table 6 also indicates that of the 64% switching from Vocational Certificate, 42% switched to AA Only, and 36% switched to a Bachelor's degree as a goal at the end of the course. Likewise, of the 64% that switched from initially seeking to enhance their employment opportunities, the great majority (63%) switched to a "higher" goal of a certificate or degree. In fact, a third of these students switched to a Bachelor's degree as a goal. In general then, except for those initially selecting the highest goal of Bachelor's With AA, when students changed their goal choice, the great majority changed them to a higher or more difficult to obtain goal. For the most part, attending community college and taking a math course is correlated with a raise in student aspirations.

Table 7 compares the goal distribution of those who completed the drop survey to those who completed the post-survey. While the drop survey sample is small (367 of the approximately 3,000 who dropped during the semester), it indicates that those dropping had as a group somewhat lower aspirations than those completing. Sixty-eight percent indicated a goal of a Bachelor's degree compared to 75% of completers who indicated a Bachelor's goal on their post-survey.

These findings of stability and change in students' goals over the course of one semester are similar to those found in the Year 1/Writing and the Year 2/Reading outcomes studies.

Figure for Table 7
Percentage Distribution of Educational Goals
Post-survey vs. Drop Survey Students

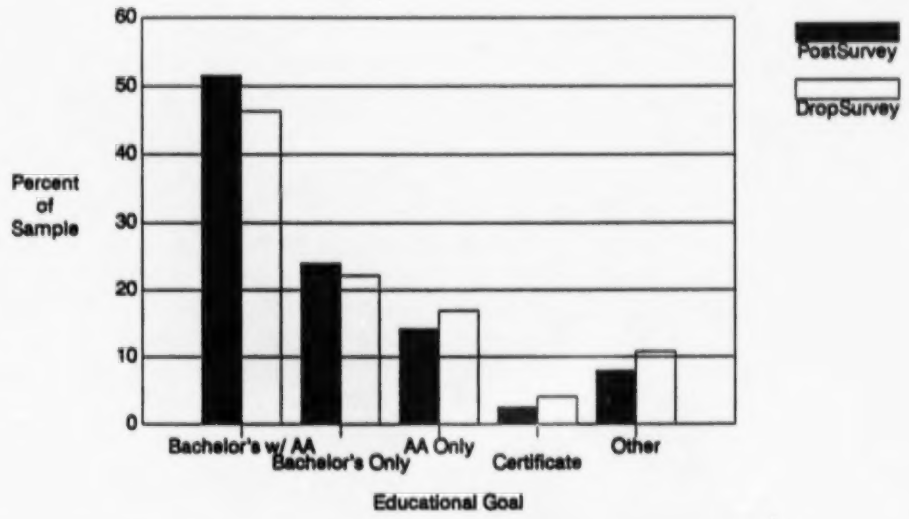


Table 7
Percentage Distribution of Educational Goals
Post-survey vs. Drop Survey Students

Educational Goal	Percent Post-survey	Percent Drop Survey
Bachelor's With AA	52	46
Bachelor's Only	24	22
AA Only	14	17
Certificate	3	4
Enhance Employment	2	3
HS Diploma	0	0
Personal Development	3	3
None	3	5
Number	4,851	387

Significant amounts of goal change occurs, much of it reflecting either higher aspirations or a slight variation on the original goal.

As in previous LARC outcomes studies, it should be noted that the educational goal categories provided on the surveys may be perceived as overlapping and non-discrete by students. It is also possible, perhaps even likely given these findings, that students further refine their goals as they progress through college.

Course Objectives and Accomplishments

On the survey administered at the beginning of the semester students were asked to choose (from a list of options provided) their reasons for enrolling in their math course. To determine whether students satisfied their course-related objectives, students were again provided with the same list of course objectives at the end of the semester and asked to indicate which they had accomplished by completing the course.

Table 8 shows the results of the post-survey of course accomplishments. About 90% of the completers indicated they improved or refreshed skills. Eighty-five percent indicated they accomplished increasing their chance of success in other courses and 76% indicated they had completed a prerequisite. Forty-four percent and 28% indicated satisfying degree or job requirements, respectively. A significant 18% indicated that they "Did not gain anything" by taking and completing the math course. The distribution of these Year 3/Math sample students among these categories of accomplishments is very similar to the distributions found for the student samples in the Year 1/Writing and Year 2/Reading outcomes studies.

Table 9 compares post-survey responses of completers to the questions about accomplishments of completers with the drop survey responses of those who dropped the course. While again noting the smallness of the drop survey sample, it is interesting to note that at least two-thirds thought they had accomplished something. Seventy-three percent

Figure for Table 8
Percentage Distribution of Course Accomplishments
Post-survey Students

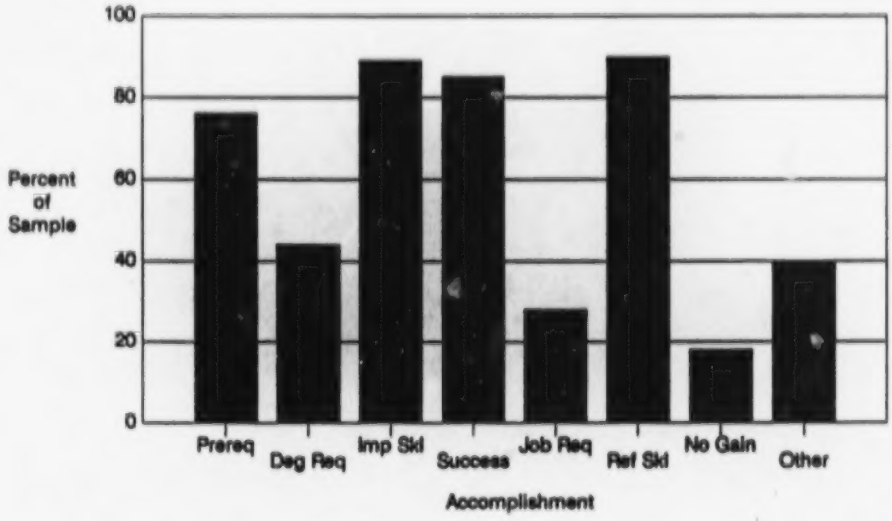


Table 8
Percentage Distribution of Course Accomplishments
Post-survey Students

Accomplishment	Percent Post-survey*
Completed Prerequiste	76
Satisfied Degree Requirement	44
Improved Skills	89
Increased Chance of Success	85
Satisfied Job Requirements	28
Refreshed Skills	90
Did Not Gain Anything	18
Other	40
Number	5,381

* All Students who took the post-survey.

Figure for Table 9
Percentage Distribution of Course Accomplishments
Post-survey vs. Drop Survey Students

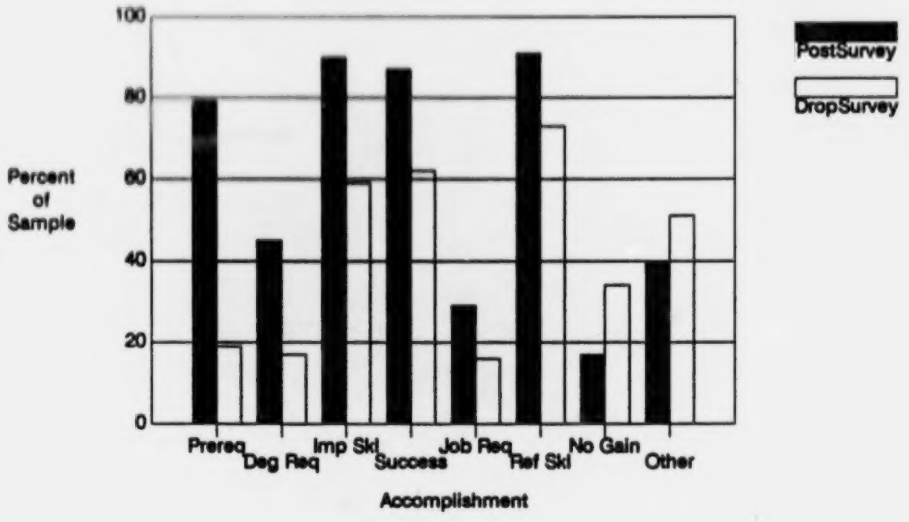


Table 9
Percentage Distribution of Course Accomplishments
Post-survey vs. Drop Survey Students

Accomplishment	Percent Post-survey*	Percent Drop Survey
Completed Prerequiste	78	19
Satisfied Degree Requirement	45	17
Improved Skills	90	59
Increased Chance of Success	87	62
Satisfied Job Requirements	29	16
Refreshed Skills	91	73
Did Not Gain Anything	17	34
Other	40	51
Number	4,851	367

* Students who also took the pre-survey.

said they refreshed their skills while 62% said they increased their chance of success in other classes. Fifty-nine percent said they improved their skills. Still, one wonders how seriously to take these results since about 20% said they completed a prerequisite or satisfied a degree requirement. It's hard to imagine how those objectives can be accomplished without completing the course. Perhaps the students meant that these were still their objectives.

These findings demonstrate that math course completers report positive experiences and are realizing benefits from mathematics education although it is cause for some concern that 18% of the completers felt they had not gained anything from their math course.

Retention

Retention

Research Questions

1. What number and percent of students:

   - successfully complete (A,B,C, or Cr grade) math courses?
   - re-enroll in college the following semester?
   - re-enroll in math courses the following semester?

2. Do students enrolled in remedial and pre-college math courses progress by enrolling in a larger proportion of non-remedial courses in the subsequent semester?

Study Process

Each college contact person was supplied with report forms listing each student who had participated in the study at their college. On the report form, college staff recorded: 1) The number of remedial and non-remedial units in which each student was enrolled during the Fall 1988 semester and the following Spring 1989 semester, 2) the grade received in the math course, and 3) enrollment in Spring 1989 semester courses including whether math courses were taken. This information, along with all data collected for the study, was submitted to the authors at Palomar College for analysis. The completion rate for these student information report forms equalled 96% of the 11,275 students that took either pre-test of math skills or pre-survey questionnaire at the beginning of the Fall 1988 semester.

Course Completion and Retention

Fifty percent of the sampled students who took a pre-test of math skills at the beginning of the Fall 1988 semester and for whom end-of-semester data were submitted completed their math course successfully; that is, with a grade of A, B, C, or Credit (see Table 10). Nineteen percent completed the course unsuccessfully; that is, with a grade of D, F, or No Credit. Thirty-one percent of those who began a math course did not complete the course;

Table 10
Distribution of Pre-test Sample by Course Completion Rates

	Successful (A,B,C,Cr)		Unsuccessful (D,F,NCr)		Non-Completer (W,I,Drop)		Totals	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Precalculus	1,019	46	369	17	831	37	2,219	100
Intermediate Algebra	1,364	47	569	20	955	33	2,888	100
Beginning Algebra	1,421	49	551	19	927	32	2,899	100
College Arithmetic	1,246	57	423	20	505	23	2,174	100
Arithmetic Skills	381	55	152	22	165	23	698	100
Totals	5,431	50	2,064	19	3,383	31	10,878	100

that is, they received a grade of W or I or dropped prior to the deadline after which a W grade must be assigned.

Table 10 also provides the distribution of course outcomes by course level. Students succeed somewhat less frequently in higher level courses than lower level courses. For example, 46% are successful in Precalculus compared to 57% in College Arithmetic. However, the proportion who are unsuccessful is not greater in higher level courses. The non-completion rate is higher instead. For Precalculus the non-completion rate is 37% while it is 23% for College Arithmetic.

While not conclusive because of the small sample, the survey of those who dropped the course provides some hints as to why students didn't complete their math course. Table 11 shows the results of that question for the 391 students who responded. Students could indicate more than one reason for dropping from a list (see Appendix C). About a third of the dropout respondents indicated the course was too difficult for them. A fourth, in perhaps a variation of the too difficult theme, said they needed more time. At least a fourth indicated a reason that is non-academic and perhaps beyond the student's control. These students checked "a change in work hours" or "family/personal reasons" as the reason they dropped the course.

Table 12 provides course completion rates by ethnic group. There appears to be a relation between ethnicity and successful course completion. Whites have the highest successful completion rate of 54% followed by Asians at 53%. All other ethnic groups have successful completion rates below the overall average of 50%. Blacks complete their math courses successfully at only a 38% rate. Hispanics complete successfully at a 43% rate. These results parallel those found in the Year 1/Writing outcomes study, although all math successful completion rates are lower than successful writing completion rates.

Figure for Table 11
Percentage Distribution of Reasons for Dropping Course
Drop Survey Students

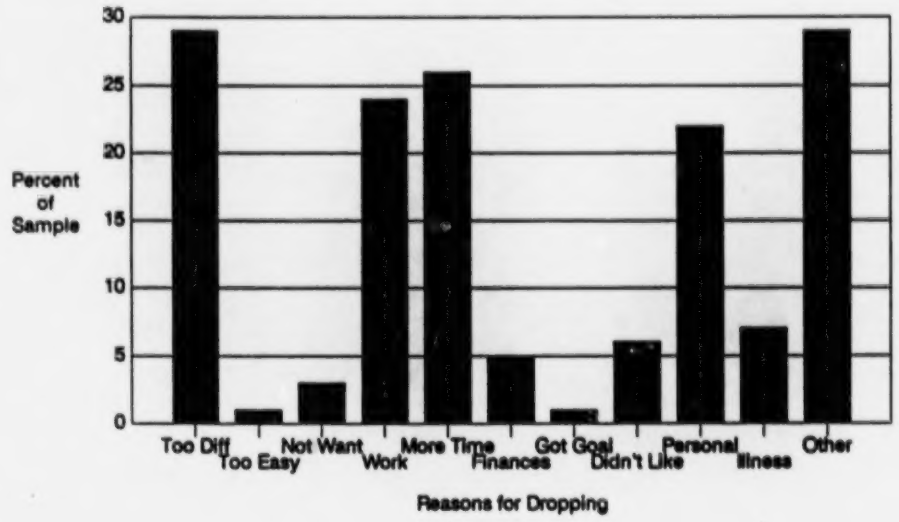


Table 11
Percentage Distribution of Reason for Dropping Course
Drop Survey Students

Reason	Percent Drop Survey
Too Difficult	29
Too Easy	1
Not What I Wanted	3
Change in Work Hours	24
Needed More Time	26
Financial	5
Reached Goal	1
Didn't Like Class	6
Personal/Family	22
Illness	7
Other	29
Number	391

Table 12
Distribution of Course Completion Rates by Ethnicity

	Successful (A,B,C,Cr)		Unsuccessful (D,F,NCr)		Non-Completer (W,I,Drop)		Totals	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
White	3,024	54	921	16	1,687	30	5,632	100
Black	283	38	190	26	269	36	742	100
Hispanic	967	43	530	24	730	33	2,227	100
Asian	597	53	200	18	329	29	1,126	100
Philippine American	114	44	49	19	99	38	262	100
American Indian	89	48	44	24	51	28	184	100
Pacific Islander	42	56	19	25	14	19	75	100
Alaskan Native	0	0	1	25	3	75	4	100
Other (Non-white)	94	55	35	21	41	24	170	100
Totals	5,210	50	1,969	19	3,223	31	10,422	100

Enrollment in College the Following Semester

Table 13 shows that 82% of the original sample students for whom Spring 1989 records data were submitted re-enrolled in college in Spring 1989. It was noted in a prior section that 75% of the sample wanted to obtain a Bachelor's degree. This high persistence-in-college rate indicates that the great majority of students persist in attempting to realize their goal.

Persistence to the next semester varies directly with the course level. Table 13 shows that the more advanced the course, the higher the persistence rate. Eighty-five percent of the Precalculus students enroll the following semester compared to 74% of the Arithmetic Skills students.

Persistence to the next semester seems to vary somewhat by ethnic group. Whites persist at the overall average rate of 81% while Hispanics and Asians persist at the somewhat higher rates of 83% and 87% respectively. The Phillippine American, Black, and American Indian persistence rates of 77%, 75%, and 73% respectively are lower than the overall average rate of 81%.

As would be expected, persistence to the next semester is directly related to success in the math course. Ninety percent of those who were successful in their math course persisted to the Spring semester compared to 78% of those who were unsuccessful. Very similar results were found in the Year 1/Writing and Year 2/Reading outcome studies for successful and unsuccessful writing and reading students. The very substantial group of math non-completers (32% of the sample) persisted at a 70% rate to the next semester. This is higher than the rates for non-completer groups in the writing and reading studies. This may be explained by the fact that the writing and reading non-completer groups were proportionately only half the size of the math non-completer group.

Table 13
Distribution of Persistence to the Next Semester

	Number Fall 1988	Number Enrolled Spring 1989	Percent Enrolled Spring 1989
Course Level			
Precalculus	2,136	1,822	85
Intermediate Algebra	2,707	2,277	84
Beginning Algebra	2,716	2,214	82
College Arithmetic	2,029	1,560	77
Arithmetic Skills	662	490	74
Ethnicity			
White	5,349	4,322	81
Black	692	520	75
Hispanic	2,061	1,711	83
Asian	1,083	938	87
Philippine American	257	199	77
American Indian	174	127	73
Pacific Islander	71	61	86
Alaskan Native	3	2	66
Other	156	133	85
Missing	404	350	86
Course Outcome			
Successful (A,B,C,Cr)	5,220	4,690	90
Unsuccessful (D,F,NCr)	1,924	1,508	78
Non-completer (W,I)	3,017	2,112	70
Totals	10,250	8,363	82

Enrollment in Math Courses the Following Semester

Table 14 shows enrollments of the Fall 1988 math students in a math course the following Spring 1989 semester. Overall, 47% of those who started a Fall 1988 math course (and for whom spring data was provided) re-enrolled in another math class the next semester. The findings in Table 14 show some variation in re-enrollment in math by course level but not so clearly direct as it is for persistence to the next semester as seen in Table 13. Variation in re-enrollment in a math course among ethnic groups is also much less pronounced than it is for persistence in general to the next semester. Asians, however, had a higher math re-enrollment rate of 53%.

Re-enrollment in another math course the next semester is clearly related to success in a math course. Fifty-nine percent of the students completing with a grade of C or better re-enrolled in math the next semester compared to only 37% of the students who received D's or F's. Non-completers re-enrolled in math at a 34% rate.

Progression Into College Level Coursework

Ideally, students who are enrolled in remedial coursework become remediated and progress on to the non-remedial and college-level curriculum. This study monitored the proportion of remedial and non-remedial course units in which the students were enrolled at the beginning of Fall 1988 and at the beginning of Spring 1989. Table 15 shows that initially, Fall 1988 math students were enrolled in an average of 2.1 remedial and 10.1 non-remedial units, or 83% non-remedial units. The next semester, they indeed progressed into a larger proportion of non-remedial units, 95%. However, the average number of units in which the students were enrolled decreased from 12.2 in Fall 1988 to 9.4 in Spring 1989. As expected, the lower the math course level in the Fall 1988, the higher were the proportions of remedial course units for both Fall and Spring semesters. However, the amount of increase in the

Table 14
Distribution of Persistence to a Math Course in the Next Semester

	Number Fall 1988	Number Enrolled in Math, Spring 1989	Percent Enrolled in Math, Spring 1989
Course Level			
Precalculus	2,189	1,082	49
Intermediate Algebra	2,791	1,289	46
Beginning Algebra	2,784	1,356	49
College Arithmetic	2,137	940	44
Arithmetic Skills	659	304	46
Ethnicity			
White	5,506	2,545	46
Black	709	318	45
Hispanic	2,138	1,008	47
Asian	1,110	592	53
Phillippine American	265	111	42
American Indian	178	79	44
Pacific Islander	73	35	48
Alaskan Native	4	1	25
Other	163	77	47
Missing	414	205	50
Course Outcome			
Successful (A,B,C,Cr)	5,297	3,117	59
Unsuccessful (D,F,NCr)	1,994	747	37
Non-completer (W,I)	3,179	1,082	34
Totals	10,560	4,971	47

Table 15
Mean Number of Remedial and Non-remedial Units Taken by Course Level, Ethnicity, and Semester

	Fall 1988			Spring 1989		
	Remedial	Non-remedial	Percent Non-remedial	Remedial	Non-remedial	Percent Non-remedial
Course Level						
Precalculus	0.6	12.8	96	0.1	10.4	99
Intermediate Algebra	1.1	12.1	92	0.2	10.0	98
Beginning Algebra	1.5	10.4	87	0.4	8.8	96
College Arithmetic	4.8	6.0	56	1.0	6.7	87
Arithmetic Skills	3.9	6.0	61	1.4	6.0	81
Ethnicity						
White	1.6	10.5	87	0.3	8.7	97
Black	3.4	8.6	72	0.7	7.6	92
Hispanic	2.5	9.4	79	0.6	8.7	94
Asian	2.6	10.6	77	0.5	10.7	96
Phillippine American	1.5	10.4	87	0.2	8.6	98
American Indian	2.8	8.8	76	0.6	7.6	93
Pacific Islander	2.8	9.6	77	0.6	9.1	94
Alaskan Native	0.0	9.5	100	0.0	6.0	100
Other	2.3	11.1	83	0.3	10.0	97
Totals	2.1	10.1	83	0.5	8.9	95

Note: For each row in the table, N ≥ 9,341; Missing ≤ 1,934; Total = 11,275.

proportion of non-remedial units from the Fall to the Spring semester was substantial for those enrolled in the lowest level math courses.

Persistence-in-College and Use of College Services

Students were asked on the questionnaire administered at the end of the Fall 1988 semester to indicate which college services they had used during the semester. Multiple responses were permitted. Those findings are combined with persistence-in-college rates in Table 16 to determine whether there may be a relationship between use of services and persistence-in-college.

Unfortunately a technical problem with the way the answer sheet was constructed lead to missing data for four of the nine services listed on the post-survey. These missing four services are: Transfer Center, Library, Tutoring, and EOPS. Table 16 reveals that at least 50% of the students utilized at least one of the services listed. Placement Testing and Counseling/Advisement were most frequently used by students.

Re-enrollment rates for students who used services appear higher than the re-enrollment rate for the total sample. That is, 82% of all students (see Table 13) re-enrolled in Spring 1989, but re-enrollment rates for students who used the services listed in Table 16 were at least 92%. For students who attended new student orientation sessions, re-enrollment rates were 94%.

Table 16
Use of College Services
and Persistence to the Next Semester

Service Used In Fall 1988	Percent Who Used Service	Persistence to Next Semester		
		Fall 1988 Number Enrolled	Spring 1989 Number Enrolled	Spring 1989 Percent Enrolled
New Student Orientation	19	912	857	94
Placement Testing	40	1,945	1,780	92
Counseling/Advisement	50	2,439	2,253	92
Financial Aid Office	16	757	709	94
Disabled Student Services	2	121	115	95

Note: Sample is of the 4,851 who took the post-survey. Due to a technical problem, data for Transfer Center, Library, Tutoring or Learning Assistance, and EOPS services is not available as it was in previous LARC student outcomes studies. Multiple responses were permitted.

Skills Acquisition

Skills Acquisition

Research Questions

1. Do students enhance their math skills, as measured by pre-/post- math tests?
2. Do students in math courses become more confident of their math ability and their ability to succeed in college?

Study Process

The surveys which were distributed in class to students at the beginning and at the end of the semester solicited self-assessments of the students' math ability and their expectations for success in college. Five point scales were used for these questions. Students also took pre-tests to measure their initial skill level upon entrance to the course and post-tests at the end of the semester to measure their exit level skills. Skills gain was calculated from the difference between the individual's pre-test and post-test scores from the pre-test. Students in all courses except Precalculus also took a second post-test to measure their "readiness" to take the next higher level math course. The use of this "readiness' post-test will be described more fully in a later section.

Skills Acquisition

Table 17 shows the mean pre-test score for the 11,270 who took the pre-test, the mean pre-test score for only the 5,589 who took both the pre-test and post-test, the mean post-test score for the 5,589 taking both the pre-test and post-test, and the mean gain calculated from the matched pairs of individuals' pre-tests and post-tests by course level. The accompanying figure displays the mean gain score stacked upon the mean pre-test scores of those taking both pre-tests and post-tests. As is evident from the figure, students who took both the pre-tests and post-tests showed substantial skills gain in all math courses. Beginning Algebra

Figure for Table 17
Mean Pre-test, Post-test, and Gain Scores by Course
(Matched Pairs Sample)

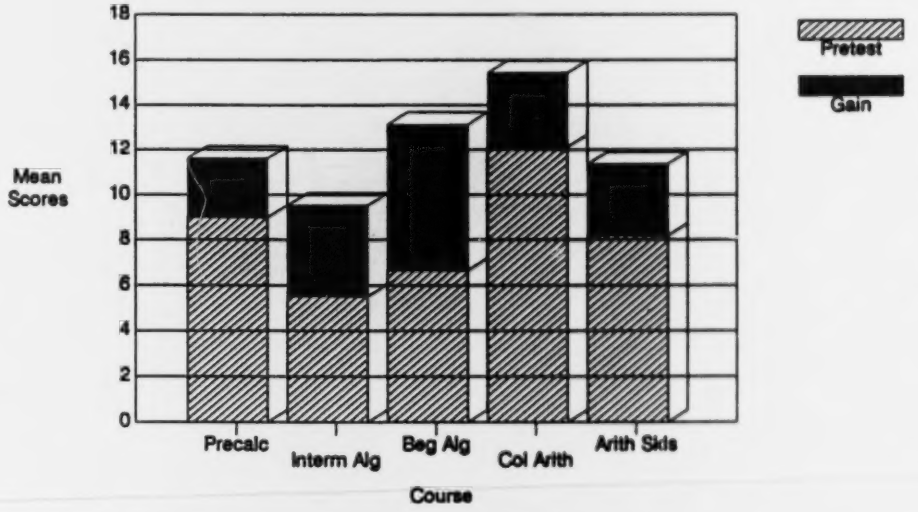


Table 17
Mean Pre-test, Post-test, and Gain Scores by Course

Course	Initial Pre-test Sample		Post-test Sample				Gain as % of Pre-test Mean
	Pre-test Mean	N	Pre-test Mean	Post-test Mean	Mean Gain	N	
Precalculus	8.10	2,281	8.97	11.61	2.64	1,112	29
Interm Algebra	5.27	2,989	5.52	9.50	3.99	1,458	72
Beg Algebra	6.18	2,870	6.65	13.39	6.49	1,447	98
College Arith	11.45	2,252	12.14	15.44	3.30	1,154	27
Arith Skills	8.33	749	8.18	11.36	3.18	418	39
Total N		11,270				5,589	

Note: There were 25 problems on each test except Precalculus which had 20 problems. Scores equal the number correctly answered. Gain scores calculated from matched pairs of pre- and post-test scores.

students nearly doubled their pre-test scores. Students in every course taking both pre-tests and post-tests gained no less than 27% over their initial pre-test score. (Note: The sum of the mean pre-test score for those taking both pre-tests and post-tests and the mean gain score equals the mean post-test score for those taking both pre-tests and post-tests.)

It would be expected that students who completed their math courses successfully - that is, with a grade of A, B, C, or Credit - would have greater gain scores than the total sample. Table 18 confirms this hypothesis. It displays the same information as Table 17 except that the post-test sample is of successful students only. Note that while 4,345 or 77% of the 5,589 students taking both a pre-test and a post-test completed their course successfully, this does not represent the overall success rate which is 50% (see Table 10).

When Table 18 is compared to Table 17 it can be seen that successful students achieved not only greater gains scores than the total sample but also had greater pre-test scores. Consequently, gain scores for successful students as a percent of their pre-test scores were nearly identical to those of the total sample. The fact that successful students did better than the total sample implies, of course, that they did substantially better than the unsuccessful students taking both pre- and post-tests.

Table 19 confirms this implication. It shows mean gain scores by course and by whether the course was completed successfully or unsuccessfully or not completed. Except for Arithmetic Skills, successful students scored substantially greater gains than those completing their course unsuccessfully. The numbers taking the post-test who did not complete the course are too small to draw solid conclusions, but perhaps surprisingly, except for Arithmetic Skills, the data indicated that they do almost as well as those completing the course successfully.

While such gains are substantial, they can take on greater meaning when placed in the

Figure for Table 18
Mean Pre-test, Post-test, and Gain Scores by Course for Successful Students (Matched Pairs Sample)

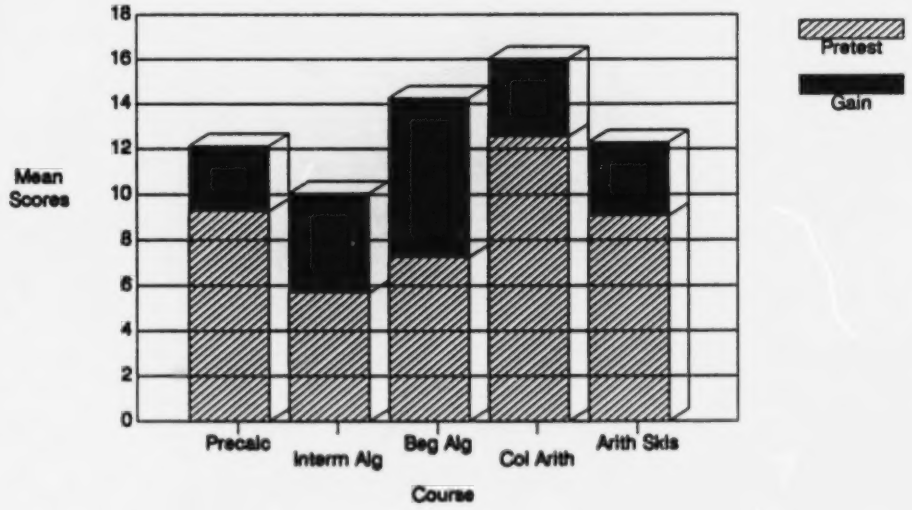


Table 18
Mean Pre-test, Post-test, and Gain Scores by Course for Successful Students

Course	Initial Pre-test Sample		Post-test Sample of Successful Students				Gain as % of Pre-test Mean
	Pre-test Mean	N	Pre-test Mean	Post-test Mean	Mean Gain	N	
Precalculus	8.10	2,281	9.26	12.14	2.88	882	31
Interm Algebra	5.27	2,989	5.69	10.05	4.36	1,141	77
Beg Algebra	6.18	2,870	7.24	13.73	7.03	1,080	97
College Arith	11.45	2,252	12.55	16.04	3.49	940	28
Arith Skills	8.33	749	9.06	12.28	3.22	302	36
Total N		11,270				4,345	

Note: There were 25 problems on each test except Precalculus which had 20 problems. Scores equal the number correctly answered. Gain scores calculated from matched pairs of pre- and post-test scores.

Figure for Table 19
Mean Gain Scores by Course and
Whether Completed Successfully or Unsuccessfully

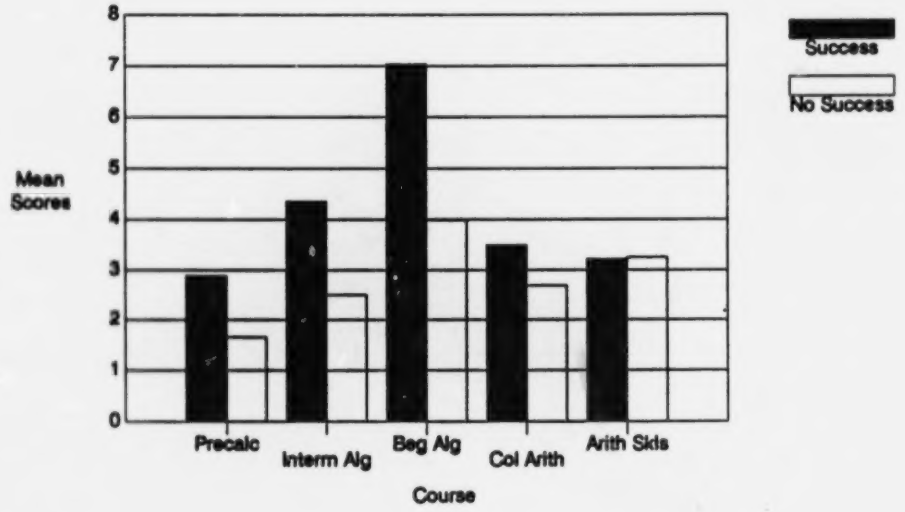


Table 19
Mean Gain Scores by Course and Whether Completed Successfully or Unsuccessfully

Course	Successful (A,B,C,Cr)		Unsuccessful (D,F,NCr)		Non-completer (I,W, or Drop)		Total N
	Mean Gain	N	Mean Gain	N	Mean Gain	N	
Precalculus	2.88	882	1.66	211	2.38	13	1,106
Intermedate Algebra	4.36	1,141	2.50	286	3.64	17	1,444
Beginning Algebra	7.03	1,080	3.99	253	7.74	27	1,360
College Arithmetic	3.49	940	2.69	175	0.65	20	1,135
Arithmetic Skills	3.22	302	3.25	95	2.35	17	414
Total N		4,345		1,020		94	5,459

Note: There were 25 problems on each test except Precalculus which had 20 problems. Scores equal the number correctly answered. Gain scores calculated from matched pairs of pre- and post-test scores.

context of the continuum of the pre-scores and post-scores along the five levels from Arithmetic Skills to Precalculus. Ideally for such a comparative context, the same test would be administered pre and post at all levels. This, in fact, was possible in the Year 1/Writing outcomes study. Two tests were used across the entire range. A writing sample test and sentence sense test measured pre-skills and post-skills across each of three levels of pre-college writing courses as well as the college level course.

Such a procedure, because of the greater variation in course objectives and content, was not possible in either the reading or this present math study. However, the math study was designed so that students took two post-tests. One post-test was the same as the pre-test so that skills gain within the course could be measured (see Table 17). The other post-test was the same test that was used as the pre-test for the next higher level math course. This second post-test enables a valid comparison of "exit" scores at one level to "entrance" scores at the next course level up since the tests are the same.

For example, those completing a Beginning Algebra course not only took a post-test on Beginning Algebra to measure skills gain but also an Intermediate Algebra "exit" post-test. The row in Table 20 dealing with Intermediate Algebra shows that exiting Beginning Algebra had a mean "exit" score to be 4.33 on their second post-test, the Intermediate Algebra post-test. On the other hand, those who started the Intermediate Algebra course in Fall 1988 achieved an average score of 5.27 on their Intermediate Algebra "entrance" pre-test. This indicates that, on average, those exiting the Beginning Algebra courses have not achieved skills equal to the average of those who entered Intermediate Algebra.

A similar gap in scores is evident in Table 20 between exit College Arithmetic scores and entrance Beginning Algebra scores and between exit Intermediate Algebra scores and entrance Precalculus scores. However, the average exit Arithmetic Skills score was virtually

Figure for Table 20
Prior Course "Exit" Score Compared to
Course "Entrance" Score

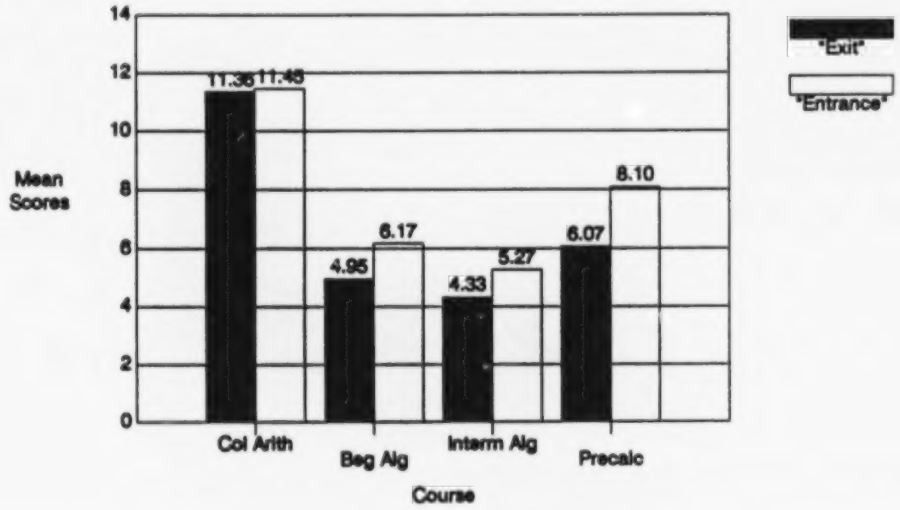


Table 20
Prior Course "Exit" Score Compared to Course "Entrance" Score

	"Exit" Scores		"Entrance" Scores	
	Mean Score of Successful Students Finishing Prior Course in Fall 1988 on this Test		Mean Score of Successful Students Starting the Course in Fall 1988 on this Test	
	Mean	**Number**	**Mean**	**Number**
Precalculus	6.07	1,354	8.10	2,281
Interm. Algebra	4.33	1,405	5.27	2.989
Beginning Algebra	4.95	1,109	6.17	2,870
College Arithmetic	11.36	418	11.45	2,252

the same as the entrance College Arithmetic Skills score.

Table 21 provides a similar comparison of exit and entrance scores for successful students only. Note that while successful students score higher than the total sample on their exit tests, they also score higher on their entrance tests. Consequently, their gap pattern between exit and entrance scores is the same as that of the total sample.

It Table 21 is compared to Table 20 it can also be seen that the higher exit scores of successful students does not even bring them up to the entrance scores of the total sample. The gap is not merely a result, therefore, of unsuccessful students bringing the average exit score down.

Math students, on these measures then, show substantial skills gain within their pre-college/remedial math courses, but, on average, not enough gain to achieve the average entrance skills at the next higher level (with the exception of the Arithmetic Skills to College Arithmetic transition). The writing outcomes study produced exactly parallel findings for pre-college/remedial writing courses (with no exceptions) using the same tests across four levels of writing courses.

The proportion of students whose exit scores were equal to or greater than the next higher level average entrance score was also calculated. This is one measure of the proportion of students "ready" for the next level. Table 22 shows, on this measure, that 56% of the Arithmetic skills students are ready for College Arithmetic; 41% of the College Arithmetic students are ready for beginning algebra; 47% of beginning algebra students are ready for intermediate algebra; and 32% of intermediate algebra students are ready for Precalculus. Corresponding figures from the writing study are: 48% of 3 levels below college writing are ready for 2 levels below writing; 41% of 2 levels below are ready for 1 level below; and 50% of 1 level below are ready for college writing.

Figure for Table 21
Prior Course "Exit" Score Compared to
Course "Entrance" Score for Successful Students

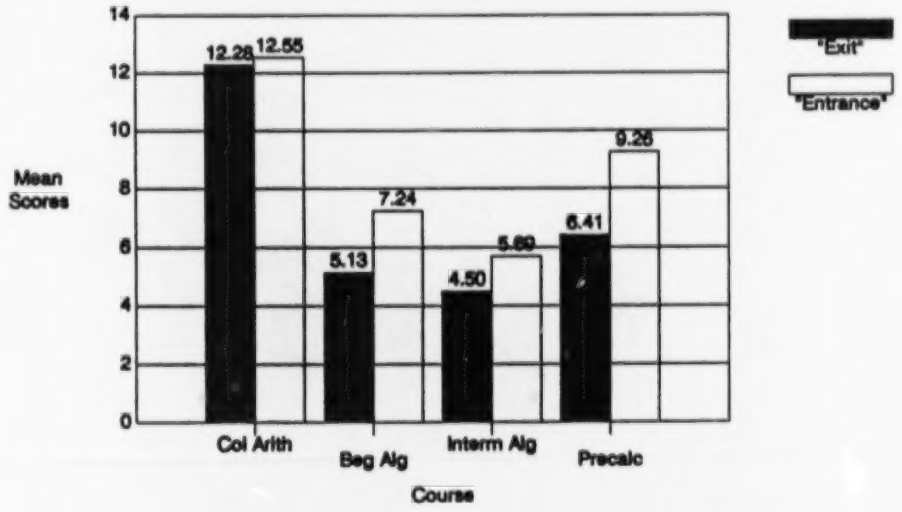


Table 21
Prior Course "Exit" Score Compared to Course "Entrance" Score for Successful Students

	"Exit" Scores		"Entrance" Scores	
	Mean Score of Successful Students Finishing Prior Course in Fall 1988 on this Test		Mean Score of Successful Students Starting the Course in Fall 1988 on this Test	
	Mean	**Number**	**Mean**	**Number**
Precalculus	6.41	1,061	9.26	882
Interm. Algebra	4.50	1,108	5.69	1,141
Beginning Algebra	5.13	898	7.24	1,080
College Arithmetic	12.28	302	12.55	940

Table 22
Percent of Completing Students "Ready" for Next Level by Having Exit Scores Equal To or Greater Than the Next Level Entrance Mean

Test Taken	"Entrance" Mean (Rounded to Whole Number)	Percent of Students Whose "Exit" Score ≥ Mean "Entrance" Score	
		Percent	Number Who Took This "Exit" Test
Precalculus	8	32	1,354
Intermediate Algebra	5	47	1,405
Beginning Algebra	6	41	1,109
College Arithmetic	11	56	418
Arithmetic Skills	8	No Exit Test Taken at the End of a Lower Course	

Table 23
Percent of Successful Students "Ready" for Next Level by Having Exit Scores Equal To or Greater Than the Next Level Entrance Mean

Test Taken	"Entrance" Mean (Rounded to Whole Number)		Percent of Students Whose "Exit" Score ≥ Mean "Entrance" Score		
			Percent		Number Who Took This "Exit" Test
	All	Successful	vs. All	vs. Successful	
Precalculus	8	9	37	28	1,061
Intermediate Algebra	5	6	50	36	1,108
Beginning Algebra	6	7	44	34	898
College Arithmetic	11	12	64	56	302
Arithmetic Skills	8	9	No Exit Test Taken at the End of a Lower Course		

Table 23 provides an analysis similar to that of Table 22 for successful students. It compares the proportion achieving an exit score greater than or equal to the mean entrance score of both the total sample and successful students only at the next higher level. A somewhat greater proportion of successful students achieved exit scores greater than or equal to the mean entrance score of the total group than did the total group. However, when the exit scores of successful students are compared to the mean entrance scores of successful students only at the next level, the proportion with an exit score greater than or equal to the mean entrance score is not a great. This confirms, from another perspective, the gap existing (except for Arithematic Skills) between the exit and entrance scores.

Table 24 and its corresponding graph displays the mean gain scores by sex for each course for those taking both the pre-test and post-test. Females seem to gain slightly more at each level than males.

Tables 25 and 26 provide the mean pre-test scores and the mean gain scores by ethnicity for those students who took both a pre-test and corresponding post-test. Figures A through E for Tables 25 and 26 display mean pre-test and gain scores for the four ethnic groups (Black, Hispanic, Asian, and White) with the largest sample sizes.

Two general findings can be extracted from Figures A to E. First, gain scores seem to vary by ethnic group in each of the five levels of math courses. Either Whites or Asians, depending upon the course, show larger skill gains than Blacks and Hispanics. Among these four ethnic groups, Whites showed the largest gains in three courses and Asians the largest in two courses (See also the Figure for Table 26). Hispanics gain less than Blacks in three of the five courses (Beginning Algebra, Intermediate Algebra, and College Arithmetic). Hispanics equal Black gains in Precalculus and Arithmetic Skills.

A second generalization from Figures A to E is that Black and Hispanic mean entrance

Figure for Table 24
Mean Gain Scores by Sex and Course

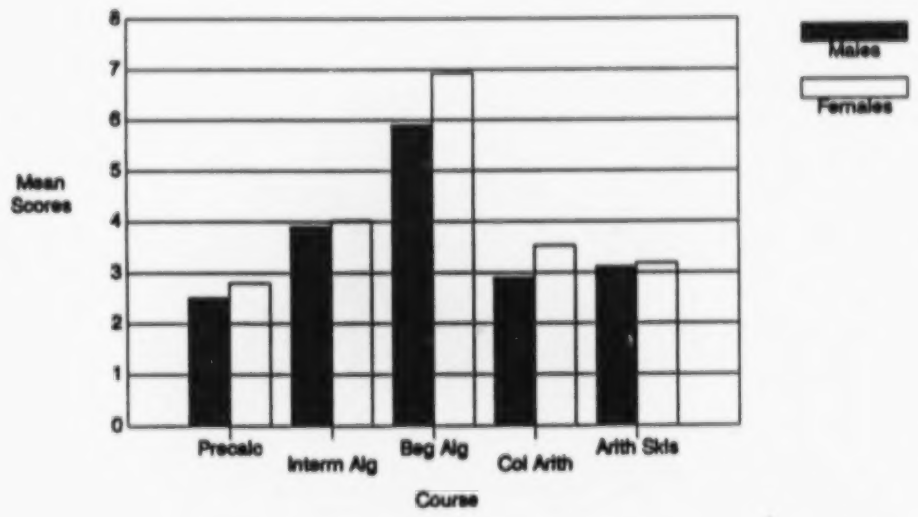


Table 24
Mean Gain Scores by Sex and Course

Course	Males		Females	
	Mean Score	Number	Mean Score	Number
Precalculus	2.51	669	2.80	431
Intermediate Algebra	3.91	662	4.02	780
Beginning Algebra	5.91	587	6.93	784
College Arithmetic	2.91	409	3.53	733
Arithmetic Skills	3.11	136	3.18	278
Total N		2,469		2,006

Figure for Table 25
Mean Pre-test Scores by Ethnicity and Course
(Sample Taking Both Pre- and Post-tests)

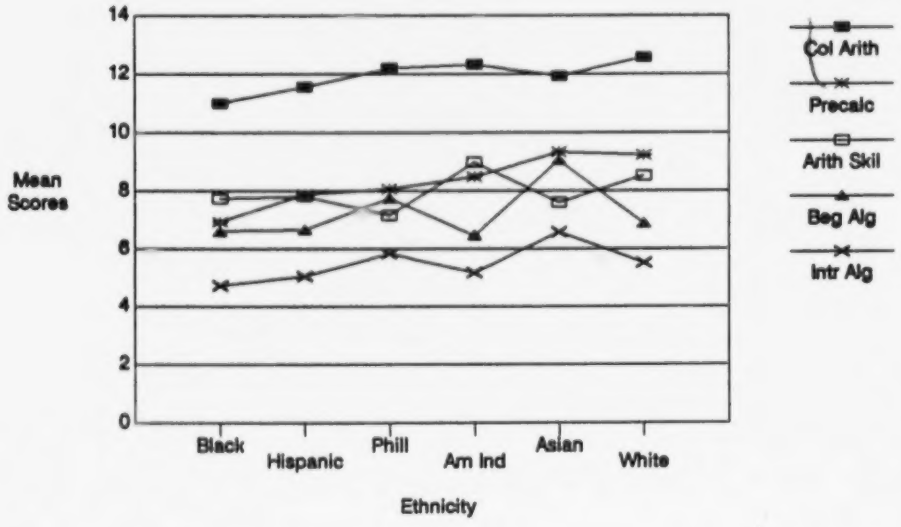


Table 25
Mean Pre-test Scores by Ethnicity and Course
(Sample Taking Both Pre- and Post-tests)

Course	Am Indian		Black		Philippine		Hispanic		White		Asian		Pac Island		Other	
	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
Precalculus	8.50	12	6.93	30	8.08	36	7.89	125	9.24	600	9.34	264	12.33	6	8.16	25
Interm Algebra	5.17	23	4.73	67	5.82	33	5.05	240	5.50	816	6.58	186	4.17	12	6.23	22
Beg Algebra	6.47	15	6.61	72	7.76	34	6.66	274	6.88	776	9.06	98	10.38	8	6.91	21
Coll Arithmetic	12.33	27	11.01	93	12.21	19	11.56	282	12.68	630	11.94	50	12.89	9	11.35	17
Arithmetic Skills	9.00	13	7.75	55	7.17	12	7.82	103	8.53	158	7.60	50	8.29	7	11.14	7
Total N		90		317		134		1,024		2,980		648		42		92

Figure for Table 26
Mean Gain Scores by Ethnicity and Course
(Sample Taking Both Pre- and Post-tests)

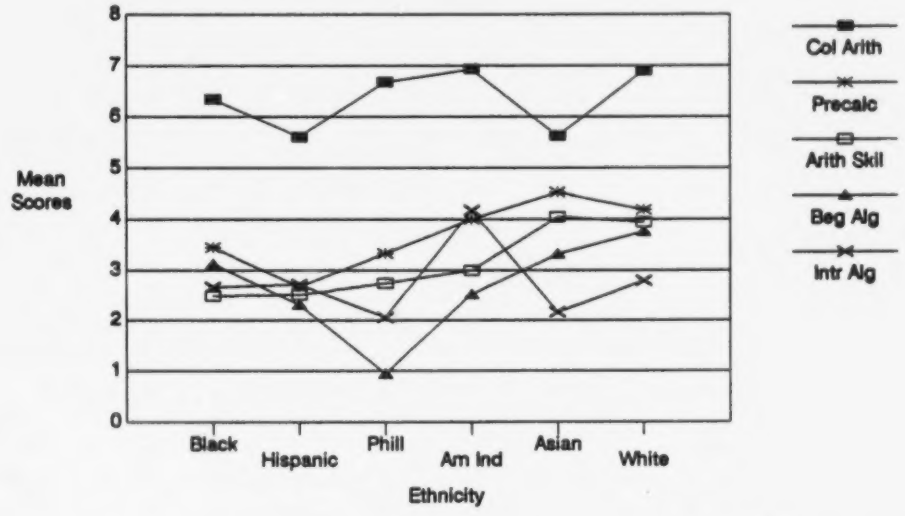


Table 26
Mean Gain Scores by Ethnicity and Course
(Sample Taking Both Pre- and Post-tests)

Course	Am Indian		Black		Phillippine		Hispanic		White		Asian		Pac Island		Other	
	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N
Precalculus	4.17	12	2.67	30	2.06	36	2.73	125	2.79	600	2.17	264	-0.33	6	2.96	25
Interm Algebra	4.00	23	3.45	67	3.33	33	2.68	240	4.19	816	4.53	186	4.67	12	5.36	22
Beg Algebra	6.93	15	6.35	72	6.68	34	5.61	274	6.90	776	5.63	98	3.75	8	5.67	21
Coll Arithmetic	2.52	27	3.12	93	0.95	19	2.32	282	3.76	630	3.32	50	4.11	9	4.29	17
Arithmetic Skills	3.00	13	2.49	55	2.75	12	2.51	103	3.94	158	4.04	50	1.71	7	1.57	7
Total N		90		317		134		1,024		2,980		648		42		92

Figure A for Table 25 and 26
Mean Pre-test, Post-test, and Gain Scores by Ethnicity
for Arithmetic Skills

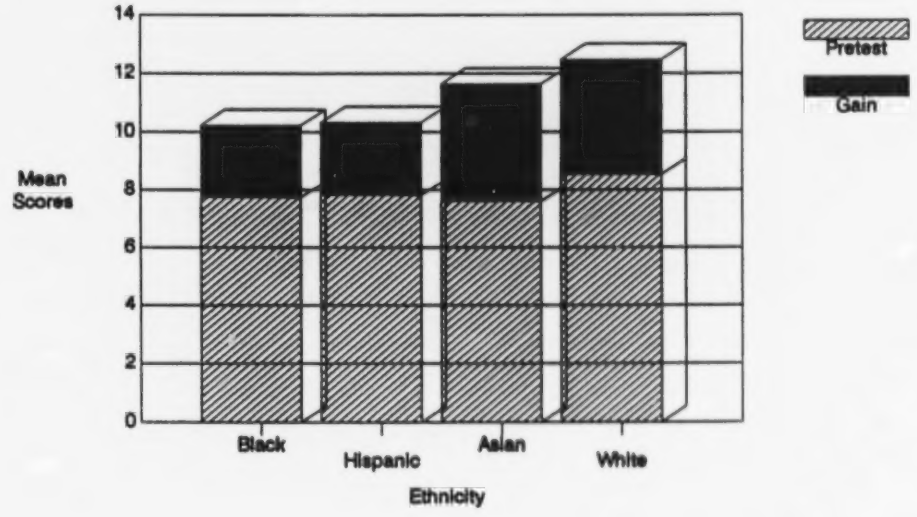


Figure B for Table 25 and 26
Mean Pre-test, Post-test, and Gain Scores by Ethnicity
for College Arithmetic

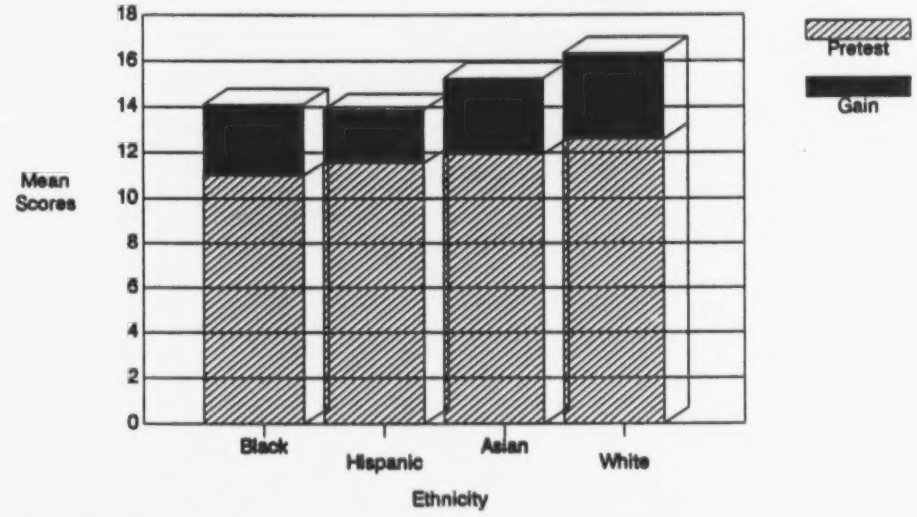


Figure C for Table 25 and 26
Mean Pre-test, Post-test, and Gain Scores by Ethnicity
for Beginning Algebra

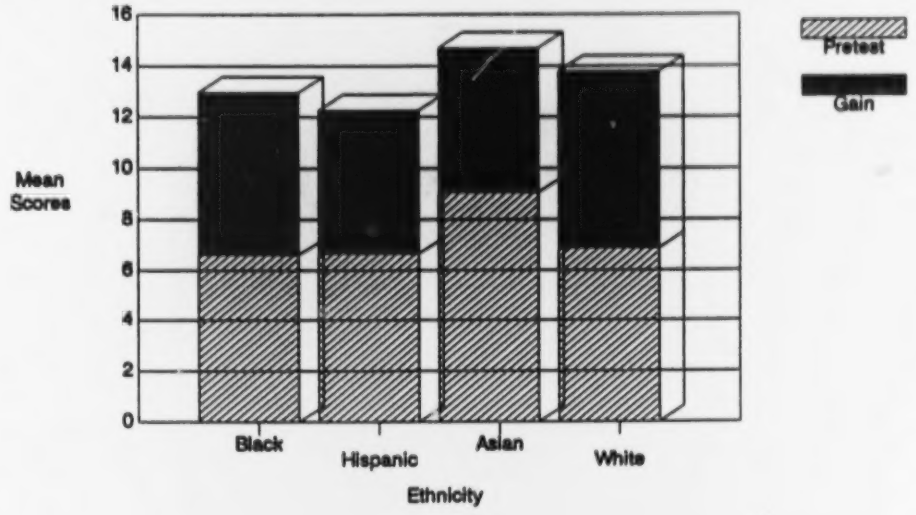


Figure D for Table 25 and 26
Mean Pre-test, Post-test, and Gain Scores by Ethnicity
for Intermediate Algebra

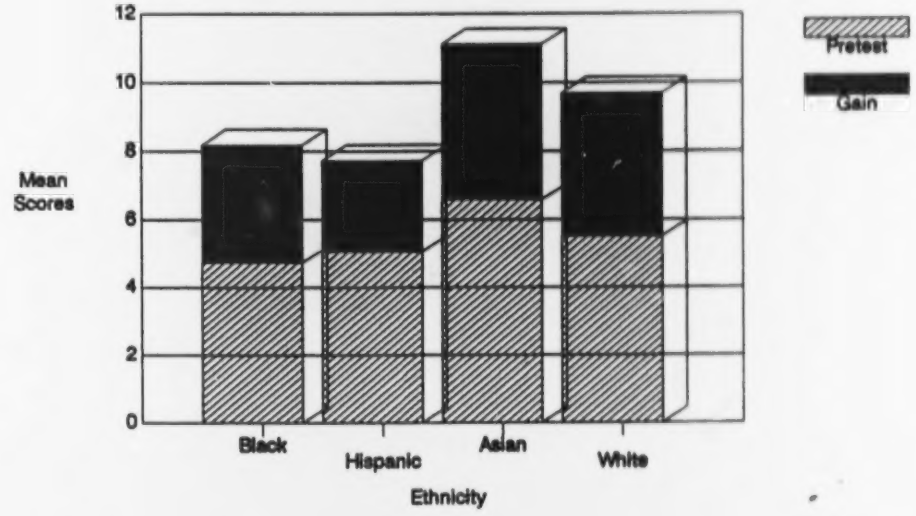
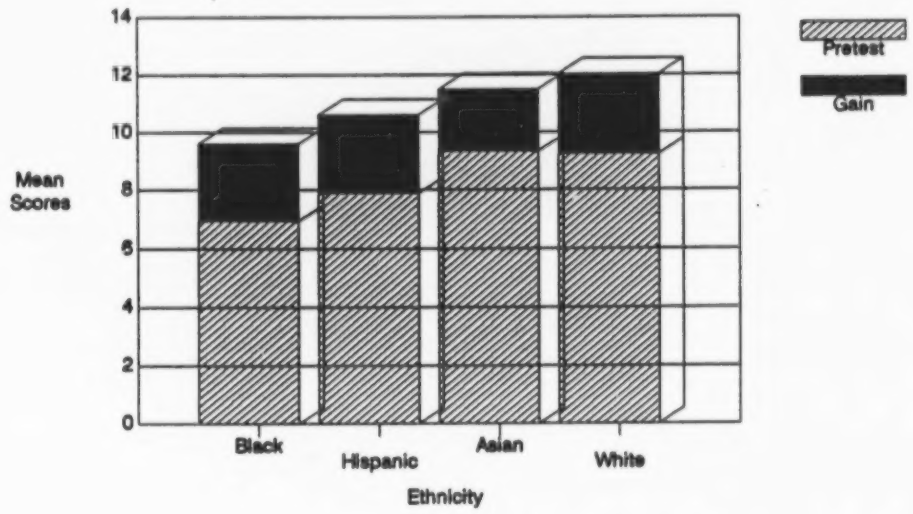


Figure E for Table 25 and 26
Mean Pre-test, Post-test, and Gain Scores by Ethnicity for Precalculus



pre-test scores are lower than Whites and Asians. In two courses, Beginning Algebra and Intermediate Algebra, Asian pre-test scores are clearly higher than White pre-test scores.

Since Blacks and Hispanics generally score lower on the pre-tests than Asians and Whites, and since they also generally show smaller skills gains, Black and Hispanic students will fall even farther behind Asians and Whites than they were when they started their math courses. Except in Beginning Algebra and Intermediate Algebra, even Asians as well exit math courses with lower average scores than Whites.

Self-Assessment of Math Ability and College Success

Students were asked "how capable do you feel about your mathematics skills" on the pre-surveys and post-surveys. They could rate their math ability on a scale of one to five, where one corresponds to "very poor in math " and five to "very good in math". The surveys also asked "how successful do you believe you will be in college" on a similar five-point scale. The purpose of these items was to measure student self-assessments of skills level and growth and expectations for succeeding in college. It was expected that these student self-assessments would directly correlate with success and skills gains in math courses.

Table 27 shows the distribution of students' self-assessments of math ability at the beginning and at the end of the semester for students who took both surveys. The table also shows the proportion of those selecting a given pre-test self-assessment who made the same assessment on the post-survey.

On the pre-survey, for course completers, the distribution of self-assessment of math ability was: 5% very poor, 18% poor, 52% okay, 20% good, and 4% very good. This is a very symmetrical distribution centered around okay. On the post-survey, the distribution was: 2% very poor, 8% poor, 57% okay, 20% good and 3% very good. The post-survey distribution

Figure for Table 27
Percentage Distribution of Self-assessment of Math Ability of Students Taking Both Pre- and Post-surveys

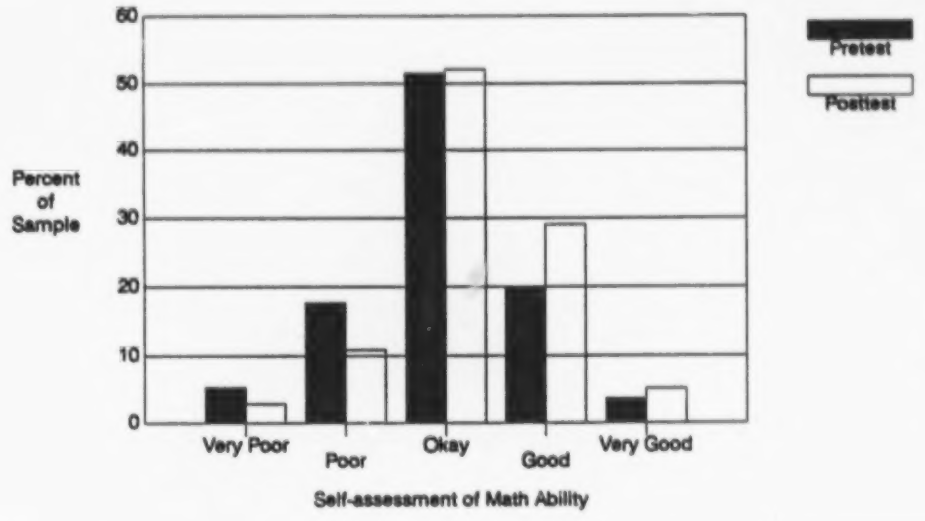


Table 27
Percentage Distribution of Self-assessment of Math Ability of Students Taking Both Pre- and Post-surveys

Self-assessment	Percent Pre-survey	Percent Post-survey	Precent of Pre- with same Post
Very Poor	5	3	19
Poor	18	11	28
Okay	52	52	66
Good	20	29	61
Very Good	4	5	47
Number	4,824	4,824	55

is shifted up compared to the pre-survey distribution. This indicates that students felt their math skills had improved as a result of completing their math class. A much more pronounced shift in the positive direction at the end of the course was noted in both the Year 1/Writing study regarding writing ability and the Year 2/Reading study regarding self-assessment of reading ability.

Table 27 also indicates that 55% of the students made the same self-assessment of math ability at the end of the course as they did at the beginning. However, 81% of those assessing themselves as able to do only "very poor in math" selected a more positive self-assessment upon completing their math course.

Table 28 shows the distribution of pre-survey self-assessments of math ability by sex by all those who started the math courses. While the distributions of males and females are similar in overall shape, the male distribution is skewed somewhat toward the positive end while the female distribution is skewed to the same degree toward the negative end. While only 19% of the males rated themselves poor or very poor in math , 30% of the females give themselves a poor or very poor rating of skill. This indicates that males feel better, on the whole, than females do about their math abilities at the beginning of their math classes. Recall, however, that Table 24 shows the females, on average, gain more skills by completing their course than males.

Table 29 shows the distribution of self-assessments of math ability at the beginning and at the end of the semester for students who dropped the course and took the drop survey. Oddly enough, these students held feelings similar to those who had not dropped. Even though the drop sample is relatively small, the data shows that students who dropped still felt "better" about their math abilities.

Table 30 shows students' pre-survey and post-survey self-ratings regarding their expec-

Figure for Table 28
Percentage Distribution of Pre-survey Self-assessment of Math Ability by Sex

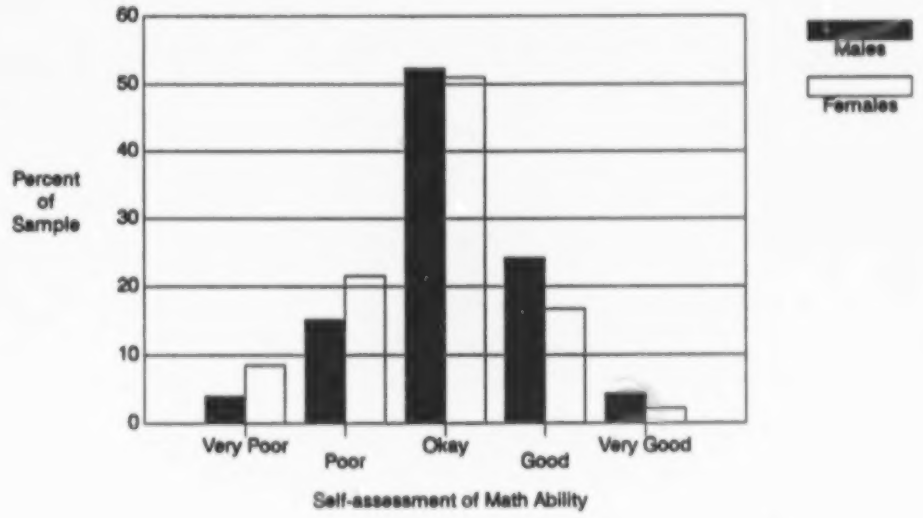


Table 28
Percentage Distribution of Pre-survey Self-assessment of Math Ability by Sex

Self-assessment	Males	Females
Very Poor	4	9
Poor	15	22
Okay	52	51
Good	24	17
Very Good	4	2
Number	10,750	

Figure for Table 29
Percentage Distribution of Self-assessment of Math Ability of Students Taking Pre-survey and Drop Survey

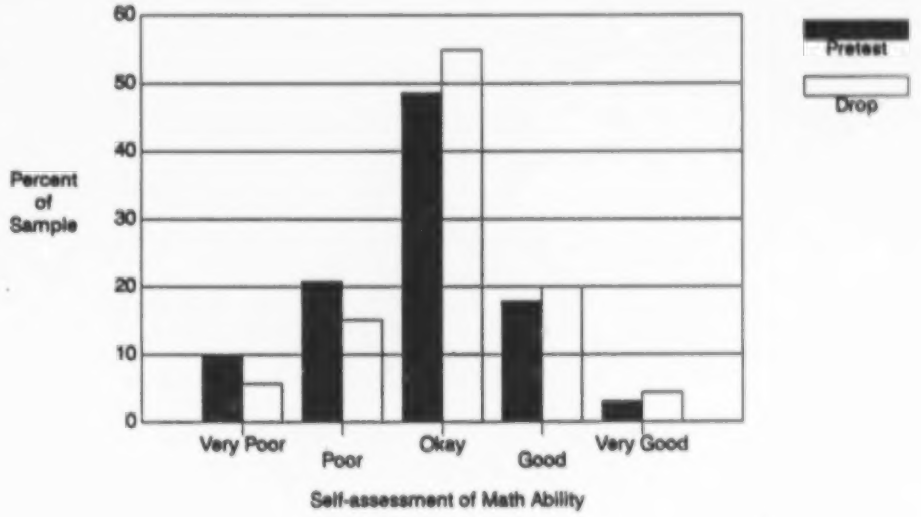


Table 29
Percentage Distribution of Self-assessment of Math Ability of Students Taking Pre-survey and Drop Survey

Self-assessment	Percent Pre-survey	Percent Drop Survey	Precent of Pre- with same Drop
Very Poor	10	6	31
Poor	21	15	33
Okay	49	55	67
Good	18	20	49
Very Good	3	4	46
Number	370	370	52

Figure for Table 30
Percentage Distribution of Self-assessment of College Success of Students Taking Both Pre- and Post-surveys

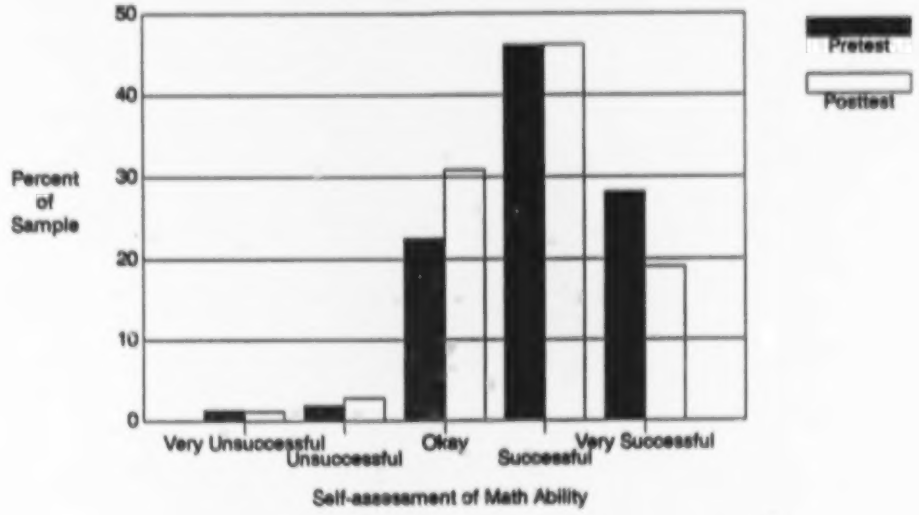


Table 30
Percentage Distribution of Self-assessment of College Success of Students Taking Both Pre- and Post-surveys

Self-assessment	Percent Pre-survey	Percent Drop Survey	Precent of Pre- with same Drop
Very Unsuccessful	1	1	23
Unsuccessful	2	3	16
Okay	23	31	63
Successful	46	46	59
Very Successful	28	19	43
Number	4,711	4,711	54

tations for being successful in college. Both pre-survey and post-survey distributions are very much skewed in the positive direction. Students are indicating that they expect to be successful in college. However, after completing their math course, students, as a whole, are not quite as positive about their college success as they were at the beginning of the course. While 28% believed they would be "very successful" at the beginning of the course, by the end only 19% had the same feelings. Still, overall, 54% did not change their self- assessment.

Pre-test and Gain Scores and Self-Assessed Math Ability

Table 31 shows mean pre-test scores for the five test math course levels by self-assessments of math skills. For each course level, students who assessed their skills higher performed better on the pre-test. For example, Figures A and B show this dramatically for Precalculus and Beginning Algebra. Table 31 shows that the mean pre-test Precalculus score for those who felt "very poor" was 5.17, while the mean for those who felt "very good" was 11.21 -- more than twice as high.

Did this correlation between self-assessment and performance on pre-tests carry over into skills gains made during the course? Table 32 and its corresponding Figures A to E provide the answer. For Precalculus, Intermediate Algebra, and Beginning Algebra there is a positive correlation between higher self-assessments of abilities and greater skills gain although the strength of the relationship is not as strong as it was for the pre-test.

For Arithmetic Skills and College Arithmetic, there is a strong negative relationship between higher self-assessments of abilities and mean skills gain scores. Since these are the remedial math classes, perhaps students who assessed themselves as good or very good in math felt they had little to learn in these classes and did not exert much effort. Conversely, those with lower self-assessments may have felt a need to work hard in the class to gain the skills required to perform well in the higher level Algebra classes.

Figure A for Table 31
Mean Pre-test Scores for Precalculus
by Pre-survey Self-assessment of Math Ability

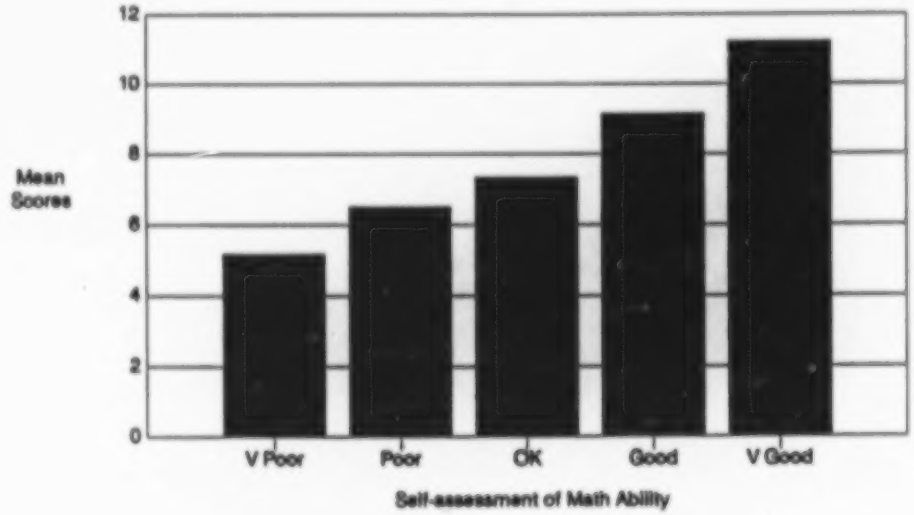


Table 31
Mean Pre-test Scores
by Pre-survey Self-assessment of Math Ability

Course	Precalculus		Intermediate Algebra		Beginning Algebra		College Arithmetic		Arithmetic Skills		Total
	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	N
Very Poor	5.17	35	4.31	124	4.93	142	8.96	244	6.27	146	700
Poor	6.51	183	4.79	457	4.94	505	10.55	592	7.85	239	2,009
Okay	7.34	1,066	5.27	1,585	6.24	1,502	12.09	1,084	9.29	288	5,582
Good	9.15	819	5.84	616	7.68	445	13.43	237	11.63	38	2,171
Very Good	11.21	145	6.18	88	9.47	68	14.84	32	10.80	10	343
Total N		2,248		2,870		2,662		2,189		721	10,805

Figure B for Table 31
Mean Pre-test Scores for Beginning Algebra
by Pre-survey Self-assessment of Math Ability

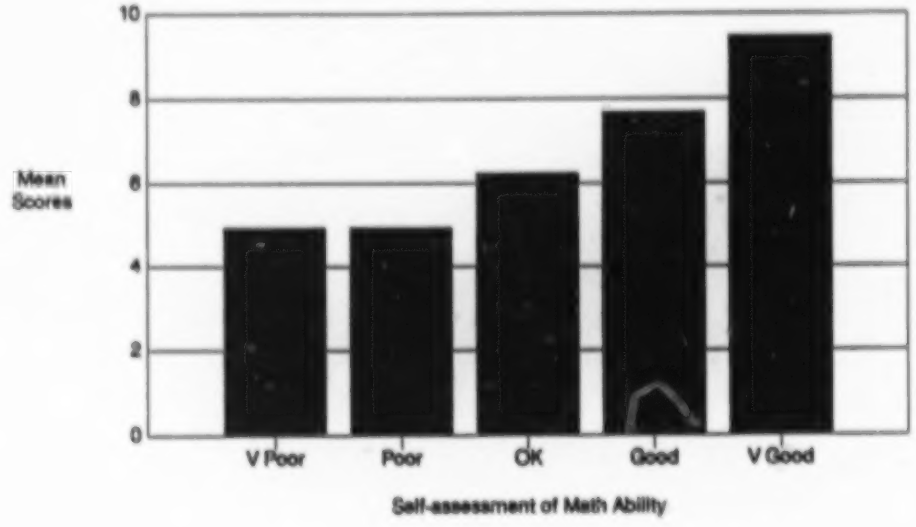


Figure A for Table 32
Mean Gain Scores for Precalculus
by Pre-survey Self-assessment of Math Ability

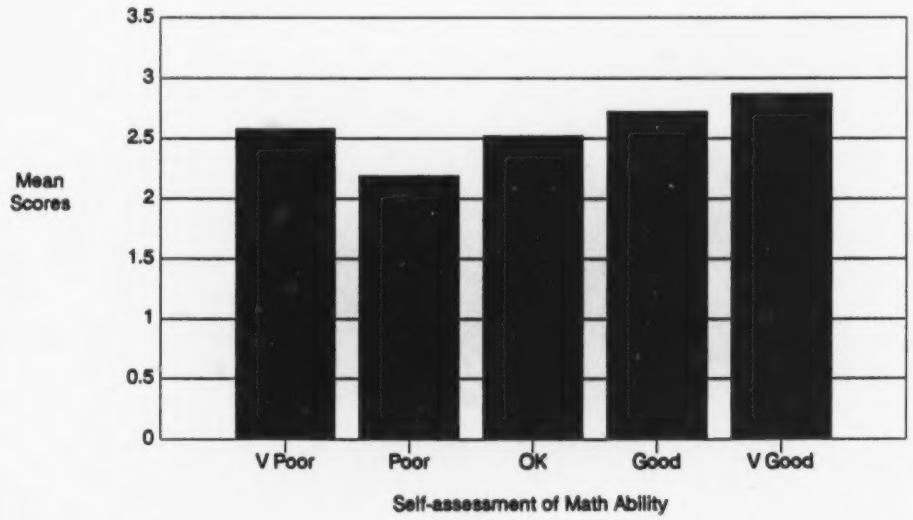


Table 32
Mean Gain Scores
by Pre-survey Self-assessment of Math Ability

Course	Precalculus		Intermediate Algebra		Beginning Algebra		College Arithmetic		Arithmetic Skills		Total
	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	N
Very Poor	2.58	12	3.76	51	5.46	48	4.37	108	4.49	73	292
Poor	2.19	57	3.26	214	6.04	220	3.75	293	3.73	153	937
Okay	2.52	492	3.82	773	6.42	734	2.98	578	2.52	156	2,732
Good	2.72	455	4.51	318	7.00	259	2.70	132	0.61	23	1,187
Very Good	2.87	86	5.22	46	6.78	36	1.87	12	-1.00	3	186
Total N		1,102		1,402		1,297		1,126		407	5,334

Figure B for Table 32
Mean Gain Scores Intermediate Algebra
by Pre-survey Self-assessment of Math Ability

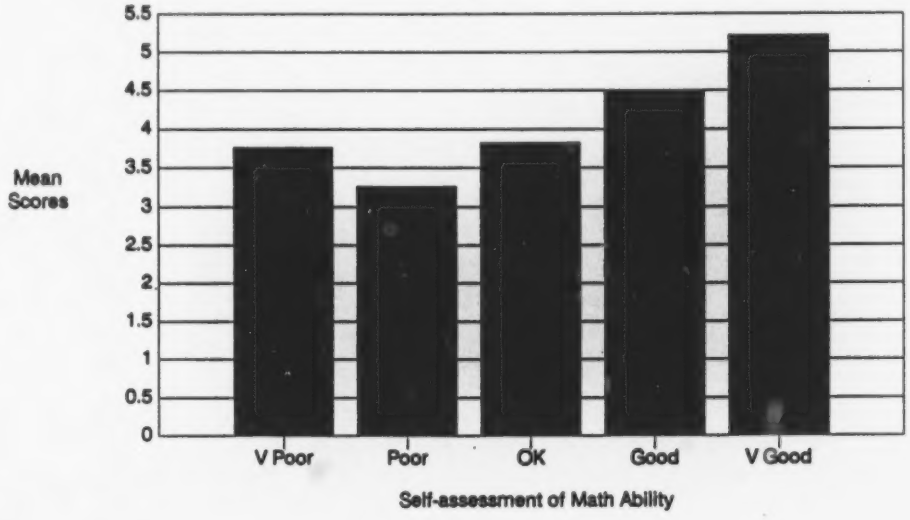


Figure C for Table 32
Mean Gain Scores Beginning Algebra
by Pre-survey Self-assessment of Math Ability

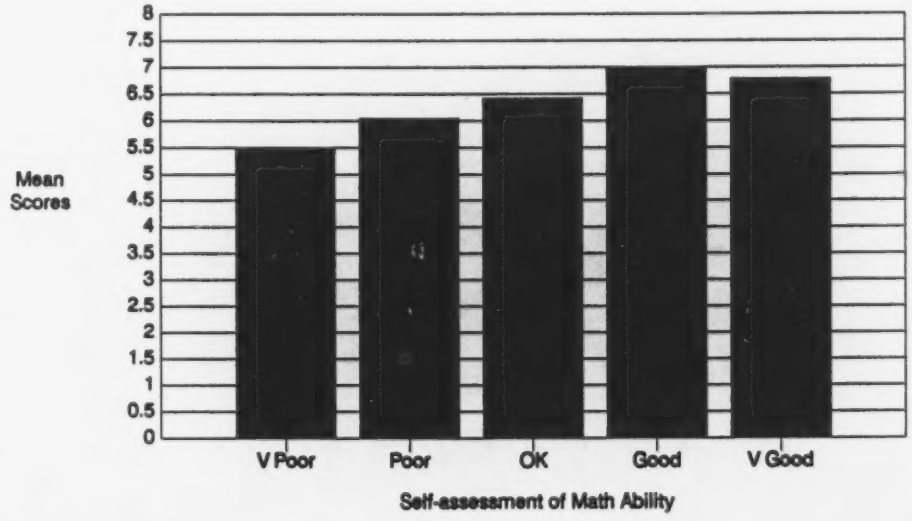


Figure D for Table 32
Mean Gain Scores College Arithmetic
by Pre-survey Self-assessment of Math Ability

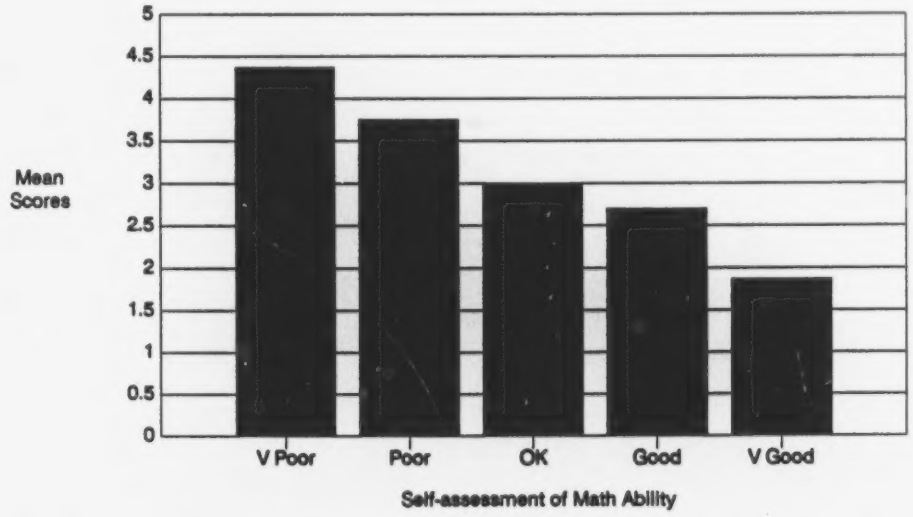


Figure E for Table 32
Mean Gain Scores Arithmetic Skills
by Pre-survey Self-assessment of Math Ability

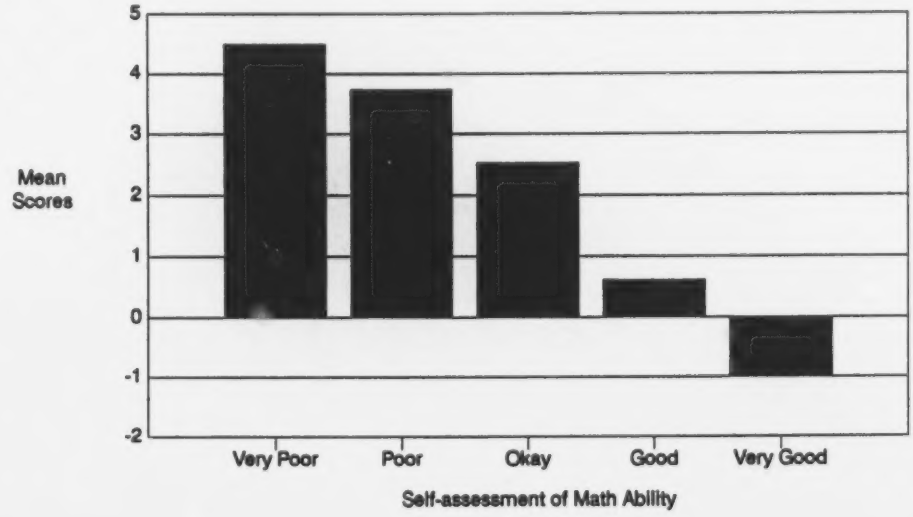


Table 33 shows the relationship between pre-survey self-assessment of math ability and whether the course was completed successfully or unsuccessfully. Clearly, the better students felt about their math abilities at the beginning of the course, the greater their probability for successful completion of the course.

Gain Scores and Expectations of College Success

Table 34 shows the gains for each level by the students' feelings about success in college. Table 34 shows that only 3% of the students form whom gain scores are available expressed a belief that they would be either "unsuccessful" or "very unsuccessful" in college. If, therefore, the analysis focuses on the students indicating they expected to be "okay," "successful," or "very successful," then for Precalculus, Intermediate Algebra, and Beginning Algebra, the higher the pre-survey self-assessment of college success, the greater the gain score. For the two Arithmetic courses, self-assessment of college success and gain scores are unrelated.

Figure for Table 33
Percentage Distribution of Whether Successful or Unsuccesful by Self-assessment of Math Ability

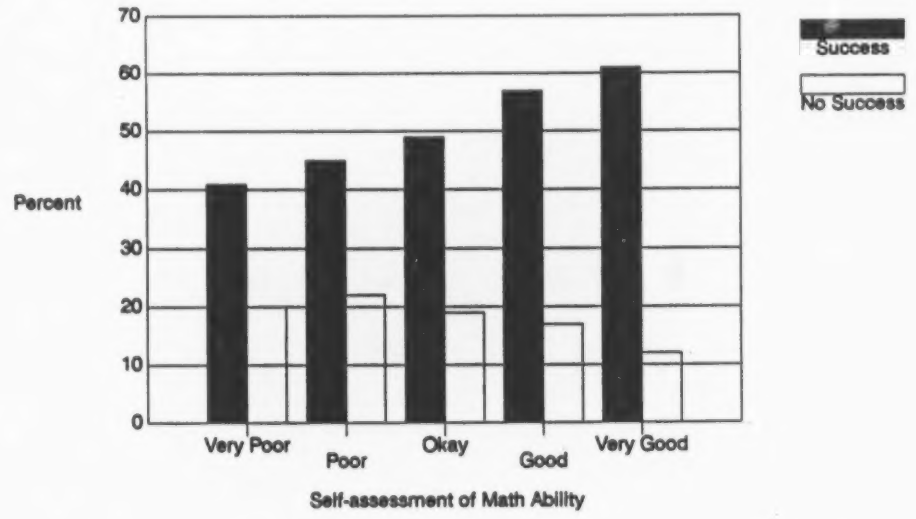


Table 33
Percentage Distribution of Whether Successful or Unsuccesful by Self-assessment of Math Ability

Self-assessment	Successful (A,B,C,Cr)	Unsuccessful (D,F,NCr)	Non-completer (W,I,Drop)
Very Poor	41	20	38
Poor	45	22	34
Okay	49	19	31
Good	57	17	26
Very Good	61	12	27
Number	10,435		

Figure A for Table 34
Mean Gain Scores for Precalculus
by Pre-survey Self-assessment of College Success

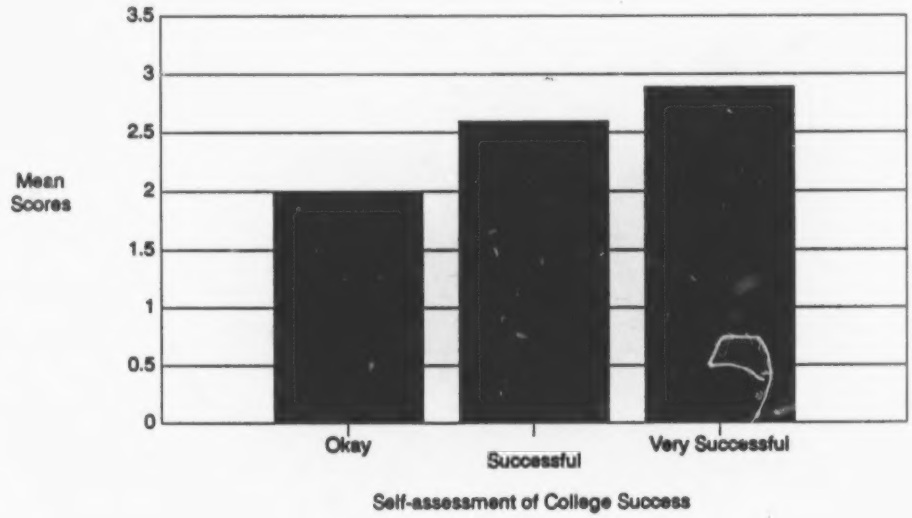


Table 34
Mean Gain Scores
by Pre-survey Self-assessment of College Success

	Precalculus		Intermediate Algebra		Beginning Algebra		College Arithmetic		Arithmetic Skills		Total
	Mean	N	Mean	N	Mean	N	Mean	N	Mean	N	N
V Unsuccessful	3.44	9	3.30	10	7.63	15	1.78	23	3.77	13	70
Unsuccessful	2.50	14	2.83	24	4.70	20	3.56	27	4.23	13	98
Okay	1.99	159	3.20	307	5.94	321	3.32	308	2.71	106	1,201
Successful	2.60	574	4.02	685	6.63	575	3.28	453	3.50	132	2,419
V Successful	2.89	341	4.50	363	6.63	358	3.32	302	3.28	137	1,501
Total N		1,097		1,389		1,289		1,126		401	5,289

Figure B for Table 34
Mean Gain Scores Intermediate Algebra
by Pre-survey Self-assessment of College Success

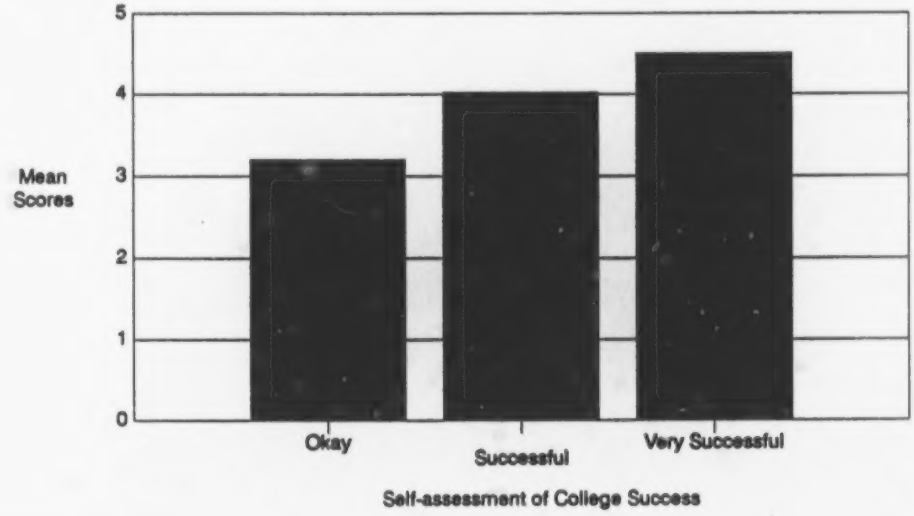


Figure C for Table 34
Mean Gain Scores Beginning Algebra
by Pre-survey Self-assessment of College Success

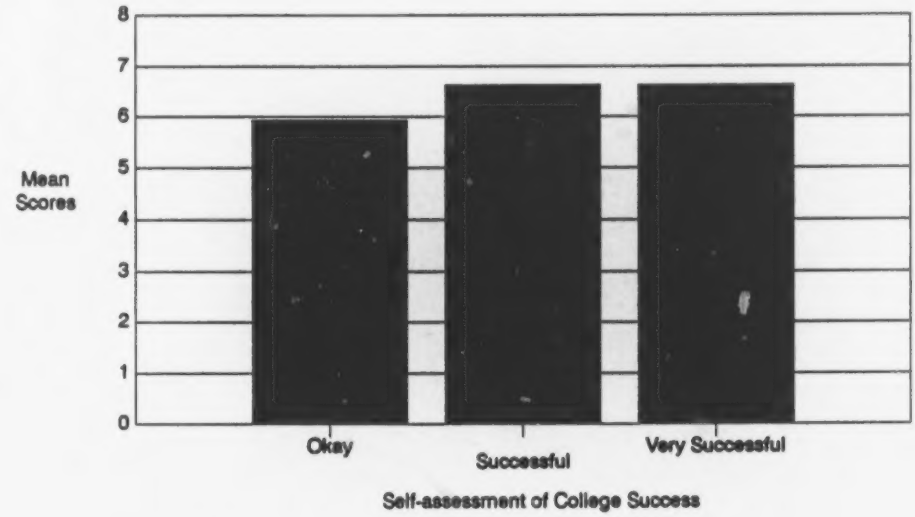


Figure D for Table 34
Mean Gain Scores College Arithmetic
by Pre-survey Self-assessment of College Success

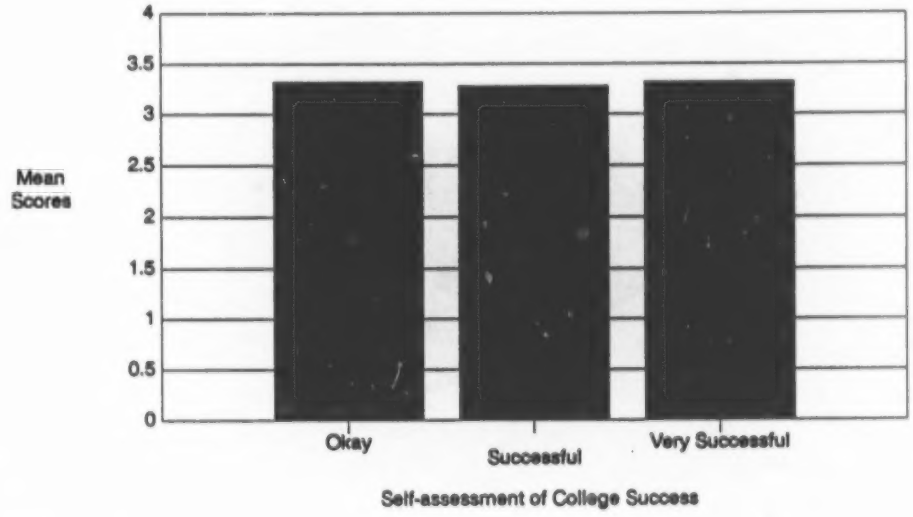
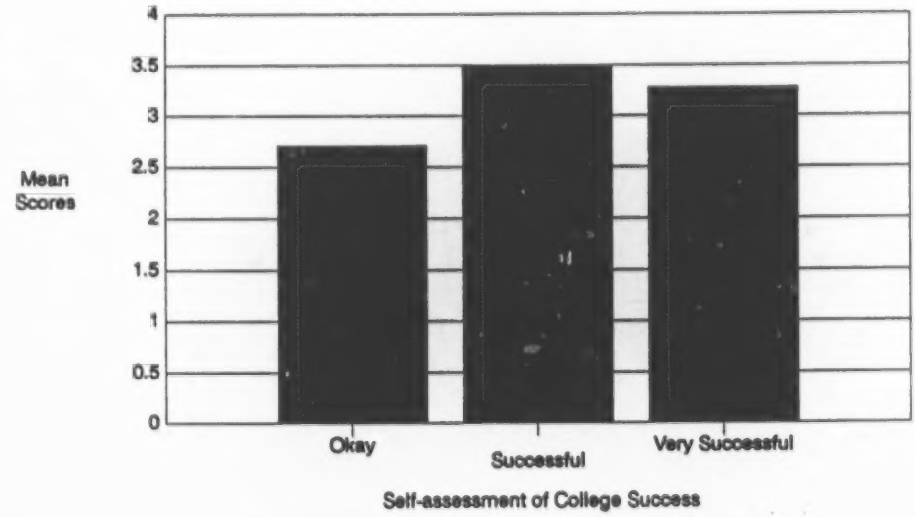


Figure E for Table 34
Mean Gain Scores Arithmetic Skills
by Pre-survey Self-assessment of College Success



Summary and Conclusions

Summary and Conclusions

Value of LARC Student Outcomes Research

The value of LARC Student Outcomes studies goes beyond their many findings. In addition to the studies' findings, colleges increased their awareness of research and assessment and of their needs and uses for accountability and program evaluation and improvement. When this series of studies began in 1986-87, colleges varied greatly with respect to their experience with cooperative research; some had engaged in extensive program evaluation and some participated in this study with trepidation because this was their first experience with shared research. Today, a majority of the California community colleges have now participated in this student outcomes research series and express enthusiasm and new levels of sophistication for outcomes assessment. Outcomes assessment has become better understood and accepted. College staff continue to develop their research methods, awareness, and abilities.

Further, these studies have produced a large data base of information on more than 22,000 students enrolled in courses in California community colleges. This data base, for which there is no precedent, is available for additional research and can be combined with other databases and study results.

Sample

The sample of students participating in the math outcomes study is demographically similar to the samples that participated in the writing and reading studies. Over half of the math sample are 19 years old or younger. The sample represents the ethnic diversity of California community college students in that 21% are Hispanic, 11% Asian, 7% black and 2.5% Philippine American.

Like students participating in the reading and writing outcomes studies, the math participants overwhelmingly indicated on the pre-survey that they intended to obtain a Bachelor's degree. Fifty-two percent indicated they planned to achieve the Bachelor's degree without acquiring an Associate's degree while 22% said they planned to acquire the Associate's degree as well. Thirteen percent of the sample were pursuing only the Associate's degree at the beginning of their math class while 3% were pursuing a vocational certificate and 7% had other goals such as personal development, job skill enhancement, or a high school diploma.

Student Goals

At the end of the math course, students were questioned about their goals again and while the overall distribution of post-survey goals choices was virtually identical to the pre-survey distribution, many students had changed their choices. For example, 25% of those initially selecting the goal of a "Bachelor's With AA" selected another goal on the post-survey. Thirty-seven percent of those initially selecting Bachelor's only, and 43% of those initially selecting "Associate's Degree Only" selected other goals on the post-survey. Fully two-thirds of those initially selecting non-degree goals selected a degree goal on the post-survey.

Results similar to these were also found in the LARC writing and reading studies. This indicates that, given categories of this type at least, students frequently reassess and change their educational goals. But at another level perhaps student's goals are more stable than these figures indicate. Of those students switching from Bachelor's With AA to another goal, the great majority selected Bachelor's Only. Similarly, of those switching from an initial Bachelor's Only, the great majority selected Bachelor's with AA. This suggests that the basic goal, a Bachelor's degree, remains stable, but that the specific means or pathway to that may change frequently. Such changes in pathways may also be reflected in changes of major.

Students initially selecting goals other than a Bachelor's tended to select "higher" goals at the end of their math course.

Self-Assessment of Skills

Math students were asked on both the pre and post-surveys to assess their level of math skills. A five-point scale was used. On the pre-survey, for course completers, the distribution was: 5% very poor, 18% poor, 52% okay, 20% good, and 4% very good. This is a very symmetrical distribution centered around okay. On the post-survey, the distribution was: 2% very poor, 8% poor, 57% okay, 20% good and 3% very good. The post-survey distribution is shifted up compared to the pre-survey distribution. This indicates that students felt their math skills had improved as a result of completing their math class. Similar results were noted in the writing and reading outcomes studies.

Skills Acquisition

The students' self-assessment of skills gain are confirmed by the results of the pre-testing and post-testing for skills acquisition in all three LARC outcomes studies. For each of the five levels of math courses studied (Arithmetic Skills, College Arithmetic, Beginning Algebra, Intermediate Algebra, and College Algebra) there is substantial skills gain. Student end-of-course scores on the tests designed by the Mathematical Association of America averaged 27% to 98% higher than their corresponding pre-test scores.

While such gains are significant and substantial, they can take on greater meaning when placed in the context of a continuation of pre-scores and post-scores along the five levels from Arithmetic Skills to Precalculus. Ideally for such a comparative context, the same test would be administered pre and post at all levels. This, in fact, was possible in the LARC writing outcomes study. Two tests were used across the entire range. A writing sample test

and sentence sense test measured pre-skills and post-skills across four levels of writing courses.

Such a procedure, because of the greater variation in course objectives and content, was not possible in either the reading or math study. However, the math study was designed so that students took two post-tests. One post-test was the same as their pre-test and thus could be used to measure skills gain within the course. The other post-test was the same test that was used as the pre-test for the next level up. This enabled a comparison of "exit" scores to the "entrance" scores at the next level up.

For example, those completing beginning algebra not only took a beginning algebra test but also an intermediate algebra test. The average score on the exit intermediate algebra test by the beginning algebra students was 4.3. The average score on the entrance intermediate algebra test by the intermediate algebra students was 5.3. A similar gap in scores was found in comparing exit College Arithmetic students with entrance beginning algebra students and exit intermediate algebra students with entrance College algebra students. However, the average exit Arithmetic Skills score was the same as the entrance College Arithmetic Skills score.

Math students, on these measures then, show substantial skills gain within their pre-college/remedial math courses, but, on average, not enough gain to achieve the average entrance skills at the next higher level (with the exception of the Arithmetic Skills to College Arithmetic transition). The writing outcomes study produced exactly parallel findings for pre-college/remedial writing courses (with no exceptions).

The proportion of students whose exit scores were equal to or greater than the next higher level average entrance score was also calculated. This is one measure of the proportion of students "ready" for the next level. On this measure, 47% of the Arithmetic Skills

students were ready for College Arithmetic; 32% of the College Arithmetic students are ready for beginning algebra; 34% of beginning algebra students are ready for intermediate algebra; and 24% of intermediate algebra students are ready for Precalculus. Corresponding figures from the writing study are: 48% of 3 levels below college writing are ready for 2 levels below writing; 41% of 2 levels below are ready for 1 level below; and 50% of 1 level below are ready for college writing.

Course Success

Two other measures of outcomes is the proportion of students successfully completing their course and the proportion who enroll in courses the following term. In the math study, of the approximately 10,000 students who took the pre-tests and for whom data was submitted, 50% completed their course successfully, that is, with a grade of A, B, C, or credit; 19% completed their course unsuccessfully in that they received grades of D, F or no-credit; 31% did not complete their course having withdrawn or received a grade of incomplete. In the writing study, 67% of the sample of approximately 5,200 were successful; 18% were unsuccessful; and 15% did not complete their course. In the reading study, 70% of the sample of 3,800 were successful; 15% were unsuccessful; and 16% did not complete their course.

Persistence

Regarding persistence in college, 82% of the initial fall math sample enrolled in courses the following spring. Corresponding persistence figures from the writing and reading study are 82% and 78%, respectively.

Concluding Remark

In conclusion, the results of this study reflect well on community college programs. It is encouraging that many more colleges are actively involved in research and assessment.

Appendices

Mathematics Class Student Survey

Instructions: Blacken The Circle Of The Letter Of Your Answer

61. What is your ethnic identity? (Choose one)
    - A. American Indian.
    - B. Black (non-Hispanic).
    - C. Philippine American.
    - D. Hispanic.
    - E. White.
    - F. Asian.
    - G. Pacific Islander
    - H. Alaskan Native
    - I. Other non-Caucasian

62. Was English your first language in the home?
    - A. Yes.
    - B. No.

63. Have you ever attended this or another college before this semester?
    - A. Yes.
    - B. No.

64. Choose one:
    - A. I have a high school diploma.
    - B. I have completed a high school proficiency exam or GED.
    - C. Neither.

65. To get into this mathematics course (Choose as many as apply)
    - A. I took a placement test.
    - B. The counselor/advisor said I should take this class.
    - C. I completed the pre-requisite in high school.
    - D. I completed the pre-requisite in college.
    - E. Other.

66. Are you currently receiving financial aid to attend college?
    - A. Yes.
    - B. No.

67. How capable do you feel about your mathematics skills? (Choose only one)
    - A. I am very poor in math.
    - B. I am poor in math.
    - C. I am okay in math.
    - D. I am good in math.
    - E. I am very good in math.

68. How successful do you believe you will be in college, on a scale of "A" to "E" where "A" means very successful and "E" means unsuccessful? (Choose the appropriate letter)

69. What is your educational goal? (Choose only one)
    - A. Obtain Bachelor's degree at a 4-year college after obtaining an AA degree.
    - B. Obtain Bachelor's degree at a 4-year college without receiving AA degree.
    - C. Obtain Associate degree (AA/AS).
    - D. Obtain a certificate.
    - E. Enhance employment opportunities.
    - F. Complete credits for high school diploma (or equivalent).
    - G. Personal development.
    - I. None of the above.

70. Why are you enrolled in this mathematics class? (Choose as many as apply)
    - A. Required before I can enroll in another class I want to take.
    - B. This course is required to complete my degree/major/program.
    - C. To increase my chances of success in other classes.
    - D. To improve math skills/gain confidence in math.
    - E. Counselor/advisor recommended I enroll in this course.
    - F. For Job requirements/needs.
    - G. For personal interest/as a refresher course.
    - H. Parent or other encouraged me to enroll.
    - I. Not sure why.
    - J. Other not listed.

LARC Math Outcomes Study

Breakdown of mean scores for all colleges in study

College Type	Small Enrollment Colleges	Medium Enrollment Colleges	Large Enrollment Colleges	Overall
Number	5	7	11	23
Pretest:				
Precalculus	6.20	7.43	8.63	8.10
N=	180	640	1,462	2,282
Interm Algebra	5.23	5.08	5.39	5.27
N=	375	937	1,679	2,991
Beg Algebra	4.79	6.33	6.53	6.18
N=	478	974	1,423	2,875
College Arith	11.64	11.95	11.06	11.44
N=	412	706	1,134	2,252
Arith Skills	8.43	9.99	7.25	8.33
N=	84	259	406	749
Pretest (Part A: Arithmetic preparation for Beginning Algebra):				
Beg Alg-Arith	15.45	15.80	15.78	15.74
N=	478	974	1548	3000
Post Test I:				
Precalculus	9.47	11.36	11.95	11.61
N=	92	274	746	1,112
Interm Algebra	7.56	9.32	10.13	9.50
N=	220	428	810	1,458
Beg Algebra	12.45	13.20	13.77	13.39
N=	221	459	767	1,447
College Arith	15.00	14.96	15.94	15.44
N=	205	395	554	1,154
Arith Skills	11.11	10.90	11.58	11.36
N=	45	102	271	418

LARC Math Outcomes Study

Breakdown of mean scores for all colleges in study

College Type	Small Enrollment Colleges	Medium Enrollment Colleges	Large Enrollment Colleges	Overall
Number	5	7	11	23
Post Test II (Preparation for next level):				
Interm Algebra	5.14	6.10	6.33	6.07
N =	220	387	747	1,354
Beg Algebra	3.42	4.34	4.61	4.34
N =	221	428	756	1,405
College Arith	3.82	5.80	4.74	4.95
N =	184	378	547	1,109
Arith Skills	1.78	4.88	1.69	2.47
N =	45	96	254	395
Gain:				
Precalculus	2.67	2.84	2.56	2.64
N =	92	274	746	1,112
Interm Algebra	2.28	4.00	4.44	3.9
N =	220	428	810	1,458
Beg Algebra	6.62	6.04	6.74	6.49
N =	221	459	704	1,384
College Arith	2.42	2.46	4.23	3.30
N =	205	395	554	1,154
Arith Skills	2.18	(.06)	4.56	3.18
N =	45	102	271	418

LARC Math Outcomes Study

Mean Scores for Small Enrollment Colleges

(<7,000 Students)

Minority:	Small (<25%)		Medium (25-40%)		Large (>40%)
Location:	R	R	S	S	U
College Code:	1	2	3	4	5
Pretest I:					
Precalculus	4.32	6.83	5.51	9.74	9.80
N=	22	24	106	23	5
Interm Alg	4.42	5.75	5.12	5.18	5.54
N=	26	63	113	147	26
Beg Algebra	4.09	4.72	7.10	4.21	2.80
N=	47	115	107	150	59
College Arith	11.72	13.83	10.65	10.21	--
N=	25	138	117	132	--
Arith Skills	8.96	--	--	--	8.19
N=	26	--	--	--	58
Pretest IA (Arithmetic preparation for Beginning Algebra):					
Beg Alg-Arith	15.89	16.03	14.93	15.73	14.20
N=	47	115	107	150	59
Post Test I:					
Precalculus	8.89	10.14	9.20	9.83	12.50
N=	9	14	55	12	2
Interm Alg	6.32	9.14	5.80	8.26	8.00
N=	19	35	59	97	10
Beg Algebra	9.70	11.78	12.37	14.07	16.08
N=	37	58	52	61	13
College Arith	13.50	15.92	14.06	15.40	--
N=	16	78	69	42	--
Arith Skills	12.67	--	--	--	10.07
N=	18	--	--	--	27

LARC Math Outcomes Study

Mean Scores for Small Enrollment Colleges

(<7,000 Students)

Minority:	Small (<25%)		Medium (25-40%)		Large (>40%)
Location:	R	R	S	S	U
College Code:	1	2	3	4	5
Post Test II (Preparation for next level):					
Interm Alg	4.42	4.26	5.29	5.84	2.00
N=	19	35	59	97	10
Beg Algebra	3.51	2.45	5.02	2.69	4.46
N=	37	58	52	61	13
College Arith	3.69	3.82	4.55	2.67	--
N=	16	57	69	42	--
Arith Skills	1.94	--	--	--	1.67
N=	18	--	--	--	27
Gain:					
Precalculus	3.11	3.29	2.95	.42	2.50
N=	9	14	55	12	2
Interm Alg	1.53	3.37	.80	2.86	3.00
N=	19	35	59	97	10
Beg Algebra	5.16	6.40	4.17	8.69	11.85
N=	37	58	52	61	13
College Arith	.94	1.83	2.78	3.50	--
N=	16	78	69	42	--
Arith Skills	3.44	--	--	--	1.33
N=	18	--	--	--	27

LARC Math Outcomes Study

Mean Scores for Medium Enrollment Colleges

(7,000 to 13,000 Students)

Minority:	Small (<25%)	Medium (25-40%)			Large (>40%)		
Location:	R	S	S	S	S	U	LU
College Code:	6	7	8	9	10	11	12
Pretest I:							
Precalculus	8.07	6.79	9.42	9.17	7.55	7.24	6.25
N=	28	13	50	64	142	107	118
Interm Alg	5.62	4.97	4.67	5.56	5.41	4.65	4.69
N=	122	145	119	127	147	143	134
Beg Algebra	7.55	6.17	7.19	5.52	6.56	4.09	6.85
N=	151		150	159	132	117	128
College Arith	12.36	12.16	12.04	11.12	--	11.85	12.25
N=	125	144	167	130	--	75	65
Arith Skills	--	--	--	--	9.34	10.17	10.29
N=	--	--	--	--	73	75	111
Pretest IA (Arithmetic preparation for Beginning Algebra)							
Beg Alg-Arith	16.49	15.53	17.42	16.14	14.89	14.06	15.50
N=	151	150	159	132	117	128	137
Post Test I:							
Precalculus	11.80	11.81	14.36	12.69	11.32	9.88	9.69
N=	20	47	25	36	50	51	45
Interm Alg	8.82	9.35	13.31	8.13	10.47	3.73	9.95
N=	65	69	48	56	76	41	73
Beg Algebra	14.84	11.92	17.38	13.58	13.60	6.23	12.15
N=	76	66	69	66	65	43	74
College Arith	16.32	15.83	17.55	14.68	--	4.23	15.63
N=	77	82	94	73	--	39	30
Arith Skills	--	--	--	--	10.92	4.50	14.48
N=	--	--	--	--	24	28	50

LARC Math Outcomes Study

Mean Scores for Medium Enrollment Colleges

(7,000 to 13,000 Students)

Minority:	Small (<25%)	Medium (25-40%)			Large (>40%)		
Location:	R	S	S	S	S	U	LU
College Code:	6	7	8	9	10	11	12
Post Test II (Preparation for next level):							
Interm Alg	4.68	6.22	7.10	5.54	6.13	--	7.04
N =	65	69	48	56	76	--	73
Beg Algebra	5.48	3.50	4.48	3.73	4.88	2.37	4.61
N =	81	66	69	30	65	43	74
College Arith	6.05	6.22	6.23	3.86	--	5.05	7.23
N =	77	82	94	56	--	39	30
Arith Skills	--	--	--	--	5.00	5.50	4.48
N =	--	--	--	--	18	28	50
Gain:							
Precalculus	2.70	3.28	5.00	3.19	2.48	1.76	2.56
N =	20	47	25	36	50	5145	
Interm Alg	3.03	4.17	8.04	2.43	5.20	(1.42)	5.04
N =	65	69	48	56	76	41	73
Beg Algebra	6.37	5.29	9.23	6.76	6.05	1.95	5.11
N =	76	66	69	66	65	43	74
College Arith	3.36	3.09	4.94	3.47	--	(8.08)	1.90
N =	77	82	94	73	--	39	30
Arith Skills	--	--	--	--	.75	(6.79)	3.32
N =	--	--	--	--	24	28	50

LARC Math Outcomes Study

Mean Scores for Large College Enrollment

(>13,000 Students)

Minority:	Small (<25%)			Medium (25-40%)				Large (>40%)			
Location:	S	S	S	S	U	U	LU	S	U	U	LU
College Code:	13	14	15	16	17	18	19	20	21	22	23
Pretest I:											
Precalculus	9.85	10.10	7.64	7.44	7.59	7.81	7.88	8.73	8.97	8.62	10.09
N=	151	136	160	162	69	170	95	134	116	134	135
Int Algebra	5.82	6.05	5.60	4.92	4.05	5.30	4.51	5.64	4.82	6.70	6.02
N=	114	139	161	182	133	197	162	142	155	169	125
Beg Algebra	4.71	2.44	5.67	6.51	6.77	5.55	6.14	7.15	7.68	9.01	6.95
N=	142	9	141	144	131	165	149	146	155	116	125
Coll Arith	10.48	--	11.44	11.70	9.39	11.27	10.51	12.15	12.08	10.08	10.97
N=	164	--	121	47	36	52	141	143	158	164	109
Arith Skill	--	11.09	9.52	7.53	10.07	5.85	--	--	--	--	--
N=	--	11	33	81	61	220	--	--	--	--	--
Pretest IA: (Arithmetic preparation for Beginning Algebra):											
Beg Alg-Ar	16.49	16.71	17.15	16.04	15.07	13.44	14.64	16.28	15.16	16.49	16.90
N=	142	134	141	144	131	165	149	146	155	116	125
Post Test I:											
Precalculus	13.84	13.17	10.37	11.47	9.43	9.98	11.98	11.90	14.52	11.22	13.44
N=	93	69	70	92	35	82	59	59	42	77	68
Int Algebra	11.00	10.13	9.31	11.21	8.54	9.95	9.01	10.76	9.28	10.85	11.52
N=	47	89	89	86	56	80	94	62	54	87	66
Beg Algebra	18.83	11.58	11.55	13.37	11.81	12.95	11.61	16.68	14.88	14.69	13.57
N=	81	67	80	71	77	66	76	66	60	70	53
Coll Arith	16.32	--	14.99	16.63	14.19	15.52	15.69	17.21	16.56	14.81	16.59
N=	99	--	71	24	21	27	29	76	63	90	54
Arith Skill	--	--	14.00	11.67	15.24	10.94	--	--	--	--	--
N=	--	--	19	57	17	178	--	--	--	--	--

LARC Math Outcomes Study

Mean Scores for Large College Enrollment

(>13,000 Students)

Minority:	Small (<25%)			Medium (25-40%)				Large (>40%)			
Location:	S	S	S	S	U	U	LU	S	U	U	LU
College Code:	13	14	15	16	17	18	19	20	21	22	23
Post Test II: (Preparation for next level):											
Int Algebra	8.83	6.58	6.20	5.07	5.64	5.50	5.66	8.21	6.48	6.31	6.45
N=	47	89	89	86	28	80	94	62	54	87	31
Beg Algebra	5.49	1.91	3.09	3.73	3.94	5.32	5.01	5.74	5.51	6.06	5.46
N=	81	67	80	71	77	66	76	66	61	70	41
Coll Arith	3.15	--	4.68	8.25	2.43	1.56	2.27	6.97	5.90	4.96	5.26
N=	99	--	71	24	21	27	30	76	63	90	46
Arith Skill	--	--	3.00	2.81	--	1.19	--	--	--	--	--
N=	--	--	19	57	--	178	--	--	--	--	--
Gain:											
Precalculus	3.68	2.77	1.81	3.26	1.49	1.66	2.95	1.92	3.55	2.08	2.46
N=	93	69	70	92	35	82	59	59	42	77	68
Int Algebra	4.89	3.98	3.66	5.66	4.55	4.33	4.53	4.45	4.96	3.40	5.09
N=	47	89	89	86	56	80	94	62	52	87	66
Beg Algebra	13.44	11.00	5.20	6.27	4.95	7.09	5.12	8.00	5.90	4.67	5.74
N=	81	4	80	71	77	66	76	66	60	70	53
Coll Arith	5.71	--	2.52	4.63	3.67	3.74	4.55	4.25	3.22	4.27	4.94
N=	99	--	71	24	21	27	29	76	63	90	54
Arith Skill	--	--	3.63	3.98	4.76	4.83	--	--	--	--	--
N=	--	--	19	57	17	178	--	--	--	--	--

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